Proceedings of Seminar on Land-related Information Systems

Provincial-Municipal Integration

12-13 December 1983

Ontario

Ministry of Natural Resources

Hon. Alan W. Pope
Minister

John R. Sloan
Deputy Minister

Proceedings of Seminar on Land-related Information Systems

Provincial-Municipal Integration

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Sponsored By
The Interministerial Committee On
Geographical Referencing
And
The Ministry of Natural Resources

Ontario
Ministry of Natural Resources
Hon. Alan W. Pope
Minister
John R. Sloan
Deputy Minister

FOREWORD

The past year's activities associated with the implementation of a comprehensive geographical referencing system for the province have focused on conducting a User Needs Study and analysing the results of the study for input into the design of conceptual and functional models for both provincial and municipal land-related information systems.

Four municipalities were selected for the study in addition to 107 groups in the Provincial Government dealing with land-related information. The four municipalities analysed in the User Needs Study were selected from a field of forty-seven applicants, which responded to an invitation presented at the seminar on Land-Related Information Systems sponsored by the Ministry of Natural Resources in December, 1982. The municipalities were chosen based upon: their willingness to participate in and support the study, their capability to provide staff with relevant expertise, provide typing and support services, their desire to be involved in any subsequent pilot projects and system implementation activities, and a number of other factors.

The members of the Interministerial Committee on Geographical Referencing (ICOGR) supplied the names of contacts to be interviewed in their respective ministries. These contacts were to include all groups that use or supply land-related information.

The User Needs Study as a whole, addressed the land-related systems within Provincial agencies and the Ontario municipalities of Cambridge, Mississauga, Oxford County and Woodstock. These municipalities represent a range in size from the City of Woodstock which covers 2,347 hectares with a population of 26,000, to the City of Mississauga, which covers 28,750 hectares and has a population of approximately 325,000.

The Provincial interviews were conducted in 14 provincial agencies and two corporations. These included: Ministry of Agriculture and Food, Ministry of Citizenship and Culture, Chief Election Officer, Ministry of Consumer and Commercial Relations, Ministry of the Environment, Ministry of Government Services, Ministry of Municipal Affairs and Housing, Ministry of Health, Ministry of Natural Resources, Ministry of Revenue, Ministry of Transportation and Communications, Ministry of Tourism and Recreation, Ontario Hydro, Ontario Provincial Police, Bell Canada, and Union Gas.

Once the four municipalities for the study were chosen, and the provincial groups to be studied identified, a team of interviewers to gather data were selected, familiarized with the intent, background and focus of the work, and trained for project activities. Over 100 interviews were conducted in the four municipalities studied and approximately 110 interviews were conducted with provincial agencies.

Two reports were published on the User Needs Study:

- User Needs Study Land-Related Information Systems Municipal Report 1983 (MNR #5922)

- User Needs Study Land-Related Information Systems
  Provincial Report 1983 (MNR #5921)

These reports are available from the Ministry of Natural Resources at the cost of $15.00 each.

The analysis of the findings was performed jointly by the team of interviewers and a Technical Advisory Committee. The Technical Advisory Committee subsequently developed conceptual and functional models for both municipal and provincial land-related information systems. These models together with the methodology of the study and other relative issues are covered in presentations documented in these proceedings.

J. Hugh O'Donnell, Chairman
Interministerial Committee on
Geographical Referencing

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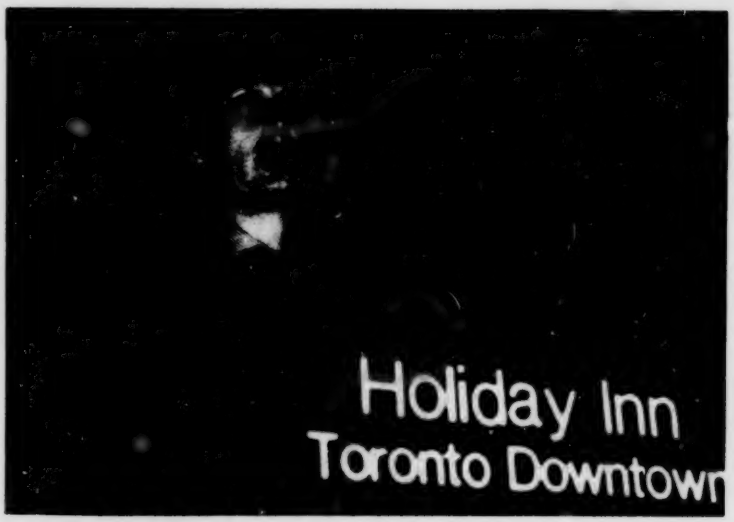
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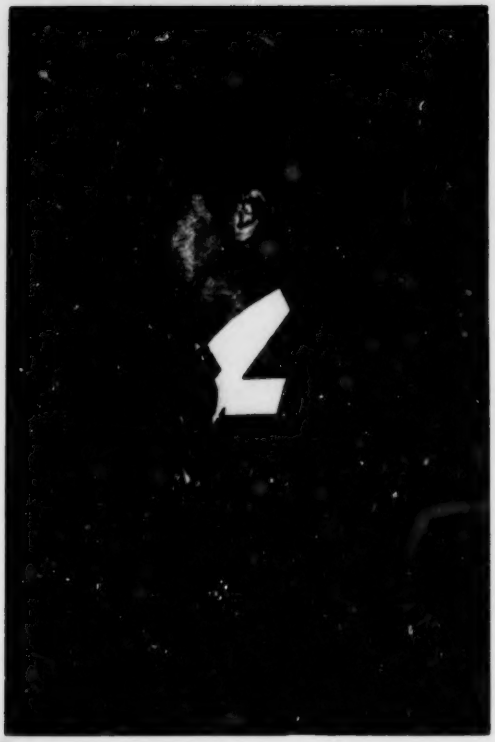

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SEMINAR ON LAND-RELATED INFORMATION SYSTEMS

Monday, December 12, 1983
and
Tuesday, December 13, 1983
Holiday Inn (Toronto) Downtown

ATTENDANCE ROSTER

MUNICIPALITIES/REGIONS

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	G. Whittington
Burlington, City of	-M. Athoe
	M. Bryan
	E. Cowley
	D. Dalgarno
	A. Hall
	K. Hall
	R. Latham
	D. Raven
Cambridge, Corporation of the City of	-J. Currie
	R. Nero
	J. Sobura
Central Mapping Agency	-K. Reiss
	R. Smith
Durham, Region of	-T. Cadman
Etobicoke, City of	-P. Bunker
	B. Lilly
	D.F. Parrish
Fort Erie, Town of	-M. Gross
Gloucester, City of	-T. Gilmour
	J. Reid
Guelph, Corporation of the City	-G. Austin
	R. Wright
Haldimand-Norfolk, Regional Municipality of	-R. Crow
Halton, Region of	-H. Wong
Hamilton-Wentworth, Region of	-M. Chidley
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	L. Lanza
	S. Roxborough
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	J.V. Falke
	P. Johnson
	R. Johnston
	J. Macko

	D. Paterson
	B. Swedak
	A. Vammus
	D. Watson
Muskoka, District of	-R. Hunter
National Capital Commission	-M. Des Chenes
Niagara, Regional Municipality of	-E. Conley
	J.S. Cotterill
	K. Forgeron
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North York, City of	-J.H. Bleaney
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Oakville, Town of	-J.D. Aitken
Orillia, City of	-R. Hawke
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Ottawa, Corporation of the City of	-T. Jones
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	L. Shallal
	M.F. Smith
Oxford, County of	-P. Atcheson
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Peel, Region of	-M. Egar
	R. Jaros
	C. Mininch
	D. Walmsley
Peel, Regional Police	-R. Bailey
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Prince Edward, City of	-T. Walker
Richmond Hill, Town of	-R. Floyd
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	W. Kowalenko

	W.R. Milne
	R. Watson
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	G. Nuttal
	J. Silva
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	R. Dopp
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Quebec, Ministere Affaires Municipales du Quebec	-Y. Bedard -M. Brunet

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Gentian Electronics Ltd.	-D. DeJong
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Gregory Geoscience	-H. Moore
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OFFICIAL OPENING

J. HUGH O'DONNELL, Surveyor General
for Ontario
Director, Surveys and Mapping Branch
Ministry of Natural Resources

Good morning, ladies and gentlemen. I'm Hugh O'Donnell and welcome to our Land-related Information Systems Seminar.

We are carrying on the fine tradition started by my predecessor, Mr. Robert G. Code, in holding these seminars. We said at last December's meeting that we would be back and here we are two days short of a year.

Because the Ontario Minister of Natural Resources, the Honourable Alan Pope, is unable to be with us today, I have the very pleasant responsibility of conveying to all the delegates at this seminar, especially those from other provinces and foreign visitors, a warm welcome from our Premier, the Honourable William G. Davis.

Mr. Pope also wishes to add his personal greetings and best wishes for a successful meeting.

In my own capacity as Chairman of the Interministerial Committee on Geographical Referencing, I am also very pleased to welcome each of you to this year's Seminar on Land-related Information Systems. C'est un grand plaisir pour moi de souhaiter la plus chaleureuse bienvenue d'etre parmi nous aujourd'hui a nos collegues de la province de Quebec. It is rewarding to find that so many participants in last year's conference have returned this year, and that there are many new participants as well. I would like to spend the next few minutes elaborating on some of the reasons for this seminar, what we hope to achieve during the next two days, and the direction we are following in the future.

It is encouraging to find that there are so many provincial, municipal and industry representatives here today. Co-operation and co-ordination of provincial and municipal agencies, as well as industry support and involvement, are vital ingredients for the design and implementation of effective land-related information systems in the Province of Ontario.

The technology for handling land-related information is a rapidly changing and evolving field. The aspects of this field in which we have become involved are particularly exciting. The development of a provincial topographic data base, and municipal land-related information systems present a wealth of new challenges and opportunities for managers and staff, as I am certain many of you will agree.

During the seminar, we will also have the opportunity to learn about some of the new initiatives which are taking place in North America. From the looks of the agenda, we will have a great deal of information to absorb.

I believe this kind of seminar is just one of the many opportunities that we -- as managers -- must use to ensure that the lines of communication between all levels of government and the private sector are maintained.

A number of advances have been made in the past year in regard to land-related information systems in Ontario. Some of these activities, which will be discussed today, include:

1) a study of selected systems in North America including systems in Burnaby, British Columbia; Eugene, Oregon; Milwaukee, Wisconsin; and Calgary, Alberta;
2) the municipal and provincial user needs studies;
3) the preparation of conceptual and functional blueprints, hereafter referred to as models, for land-related information systems structure and design;
4) development of digital mapping specifications.

With regard to the user needs studies of municipal and provincial agencies, these extensive efforts undertaken by my staff, with support from the consulting and aerial survey industries, are worthy of detailed description. Also, the co-operation from the provincial agencies interviewed and from municipalities selected for the study guaranteed its success. Today, I want to congratulate and thank the Cities of Cambridge, Mississauga, Woodstock and the County of Oxford for their input. A paper is to be presented on the methodology and procedures used in carrying out these studies. Other presentations and papers will report on the findings and some of the conclusions which were reached.

The findings from the user needs studies were essential in the preparation of conceptual and functional models for land-related information system design. These models establish the dependencies and interrelationships among data and the organizations which maintain them. The implications of these models for our particular agencies and programs will be important for each of you to consider.

Progress has also been made in a number of pertinent areas, which will be discussed on Tuesday. These areas include:

- the Ontario Basic Mapping Program
- the POLARIS Program of the Ministry of Consumer and Commercial Relations
- activities of the Ministry of Municipal Affairs and Housing, and
- the ongoing efforts to clarify topographic data base design requirements

Some important issues and considerations have also been raised during the past year. We plan to discuss them during the sessions on Tuesday. These include:

1. pilot projects
2. implementation issues and planning, and
3. questions of accuracy required in digital parcel maps

On the basis of the user needs study findings and the preparation of conceptual and functional models, we have begun to consider potential roles for the ministries, municipalities and the industry in pilot projects. These pilot projects would be directed to explore the usefulness of various techniques and strategies in implementing selected aspects of land-related information systems. From a vast array of potential pilot project options, a range of what we believe are the most meaningful options will be presented.

Issues of implementation and planning are beginning to be faced by many of you in the audience today. With regard to these concerns, a presentation will be made on suggested steps which may be taken in your jurisdiction, and considerations which should be addressed in preparing for the implementation of land-related systems of various types.

The questions of accuracy, which is required or desired in digital parcel maps for municipal use, have been a source of considerable discussion and divergent views during the past year. As a result, our Ministry distributed a questionnaire to municipalities in October. The responses to this questionnaire and our findings will be presented and discussed.

It is rewarding for me to acknowledge that the activities of the past year have deepened the general understanding regarding municipal/provincial needs for digital topographic data bases and land-related information systems.

The necessary linkages and interrelationships among various organizations and data that they maintain are also becoming clearer. The crystallizing of these requirements due to recent studies and activities lend true meaning and direction to our ongoing efforts. I believe that this progress should encourage each of us as we continue to study and consider the development of techniques and systems which meet our individual and joint needs.

I also find that enthusiasm from various municipalities, ministries and industry is building, along with co-operation in pursuing common needs and goals. This enthusiasm, and the co-operation which is engendered by it, are vital to the continued progress of these programs. Co-operation and continued enthusiasm are also critical for the successful design and implementation of cost-effective, efficient and productive tools which meet our needs.

We have a number of specific objectives within this program which I would like to outline for you:

1) we want to develop a digital topographic data base for land-related information systems in Ontario;
2) we want to establish a production environment in industry to provide this information;
3) we want to produce through industry computerized maps and by-products in sample areas so a variety of disciplines can test the utility and effectiveness of them for their own land-related applications;

4) we want to provide a monitoring capability to validate computer maps and to customize them for specific users;
5) we want to provide a focal point of expertise and land-related information systems capabilities.

Negotiations are currently underway among the various interest groups addressing the financial considerations which will assist in achieving these objectives. The seed money which is being sought will establish a capability that will in time generate returns far in excess of the cost of producing the products in the first instance. We expect to have further news on this initiative early in the new year.

Perhaps the most exciting prospect which I perceive in the field of land-related information systems is the rapid and expansive change which is continually taking place in technology. The implications which research may have for how we conduct our activities, both in the public sector and in industry, are quite fascinating to contemplate.

As I envision it, new instruments of technology will manifest themselves in three key areas: improved hardware, more advanced software, and increased institutional capability to carry out complex and wide-ranging tasks effectively. For example:

- It is realistic now to look forward to employing hand-held receiver sets linked to satellites for accurate point positioning on the ground such as the positioning of property corners.
- We will be able to employ video disc technology in conjunction with land-related information systems to video portrayal of house facades and street access. This has a major contribution in ambulance dispatch.
- Using facsimile technology, already here, drawings, forms, maps, charts and even letterheads and signatures can be transmitted over telephone lines in a matter of minutes. It is foreseeable that it will be down to 4 or 5 seconds at the cost of less than an 8-1/2x11 photocopy.

We must not forget the application of remote sensing digital imagery towards the latter part of this decade which will be approaching large scale applications and the substantial impact this will have on updating our data bases.

Relating the available tools to new applications and changing needs will continue to present new challenges to those of us in associated professions.

In light of these considerations, of essential importance is our ability to keep up with technology, to embrace the opportunity which technological advances present for us, and to incorporate them into our work to the greatest extent possible.

In conclusion, it is the intention of this meeting to further deepen all of our understandings, as well as our commitment to the pursuit and

development of compatible and productive land-related systems: systems which effectively respond to our needs. If this seminar is successful in meeting this objective, I am confident that we can look forward to another year of considerable progress, growing co-operation, and enhanced knowledge and direction towards successfully accomplishing our individual and shared responsibilities. Co-operative efforts such as this will continue to encourage government, industry, municipalities and other interest groups to work together. After all, our goals are the same. We all want to achieve greater productivity, and create jobs and trade which support our resources, our technology, our people and our communities.

I would now like to introduce today's session Chairman, Mr. Stephen Bernard Panting from the Ministry of Natural Resources, better known to all of us as Barney. Barney graduated from the University of Toronto in Civil Engineering and is a Registered Ontario Land Surveyor. He joined the former Department of Lands and Forest in 1958 and spent the following ten years in surveying activities. The succeeding ten years were spent in Engineering in the Department of Lands and Forest and then in the Ministry of Natural Resources. In 1979 he returned to the world of surveying and geographical referencing in his present position as General Manager of Surveying Services, Surveys and Mapping Branch, Ministry of Natural Resources. Ladies and gentlemen, I present to you your session Chairman for today, Barney Panting. (Applause)

SESSION CHAIRMAN INTRODUCTION, DECEMBER 12, 1983

S. B. PANTING, General Manager
Surveying Services, Surveys and Mapping Branch
Ministry of Natural Resources

Thank you very much, Hugh. Ladies and gentlemen, this is the fourth seminar on Geographical Referencing sponsored jointly by the Ministry of Natural Resources and the Interministerial Committee on Geographical Referencing. The first seminar was held in 1978 entitled "Seminar on Geographical Referencing". It was essentially a state-of-the-art report on geographical referencing here in the Province of Ontario. The second seminar was in 1981 and it too was entitled "Seminar on Geographical Referencing". That seminar provided a status report on geographical referencing activities in the province, gave an update on developments which had occurred in the intervening three years, and took a look at the direction in which georef might develop in the future here in Ontario. The third seminar that Mr. O'Donnell referred to in his opening remarks was held just a year ago and entitled "Seminar on Land-related Information Systems, Municipal/Provincial Integration". At that time we reported on what municipalities and ministries were doing in information systems development and began to focus on the need for integration of land-related information systems.

I will not review today's program, I think Hugh has pretty well touched on most of the activities during the course of the day, except I would like to remind you that there is a workshop scheduled for 7:30 this evening.

There will be a Ministry sponsored luncheon which will be served in the Floating World Room, commencing at 11:45 if we are on schedule. I understand that it is on the floor below and that it will be a sit down luncheon. What we want to do is try and stoke your internal furnaces and keep you on the edge of your chair for the afternoon because it will be a long afternoon.

At 4:00 p.m. this afternoon there will be a wine and cheese reception hosted by the Ministry of Natural Resources and the Interministerial Committee on Geographical Referencing. There will be a cash bar and it will be held in the Commonwealth Ballroom West and that is the room directly behind you. As far as coffee is concerned, coffee will be served in the reception area around 10 o'clock this morning and again around 2:45 this afternoon.

You will have noticed from the program that we have not provided for a question period following each of the speakers. We have assumed, rightly or wrongly, that most of the questions will derive from the provincial and municipal models and we made provision for their discussion during the afternoon.

To those who may have received a copy of the preliminary program in the mail and if you are planning on using it this morning, I just suggest that

you quietly fold it up and put it away. (Laughter). As far as the program that you picked up when you came in the door is concerned, well there are some changes. The first one will occur this morning, following coffee when we promote the 11:15 paper to 10:30 and the others will shift one time slot forward. There will be other changes which will occur beginning at 1:30 this afternoon and although we are switching papers and switching speakers, all the papers will be presented. I will give you those details after lunch.

I have been asked to announce that the Province of Ontario Land Registration Improvement System Program is having an open house this afternoon, commencing after this day's program. Their invitation is directed particularly to the representatives of smaller municipalities that ordinarily would not come to Toronto to attend a demonstration of the system. POLARIS and the Property Mapping Team invite you to view the system and its products until about 9:00 p.m. this evening. The address is 10 Wellesley Street East, that is at the corner of Wellesley Street East and Yonge on the 5th floor. I understand that to get into the building after 5 o'clock you shall have to ring a door buzzer and one of the security staff will let you in and direct you where to go.

I would like to take this opportunity to introduce Chief Lala. Chief Lala is the Chief of Federal Surveys of Nigeria. We are very pleased to have you here with us today. (Applause).

Our next presentation this morning is by John Kerr, entitled "Ontario's Geographical Referencing Program Update". Mr. Kerr is Manager, Geographical Referencing Services, Surveys and Mapping Branch, Ministry of Natural Resources. John is an old-timer, he is in his 35th year with the Ministry. He began his career in the former Department of Mines in 1949. John is an Ontario Land Surveyor. He held various positions in surveying in the period of 1957 to 1973, both in the Department of Mines and in the Ministry of Natural Resources. During the period 1973 to 1975 John functioned as executive secretary and member of the Task Force on Geographical Referencing, and throughout these critical geographical referencing development years, I guess we are still in those critical years, from 1977 to the present, John functioned as executive secretary and member of the Interministerial Committee on Geographical Referencing. Together with his other ongoing responsibilities as Manager, Geographical Referencing Section, John has acted as Project Manager of the Ministry User Needs Study of which you will hear a lot about during the course of the day. This has been particularly demanding because it entailed completing an underfunded project within a timeframe which was too short, and chairing a Technical Working and Interview Group as well as monitoring, prompting and at times pleading with a Technical Advisory Committee whose members were 3,500 miles apart most of the time. It is indeed a credit to John Kerr that we stand here today ready, I think, (laughter) to talk about the findings of that User Needs Study. Right now John will give us an update on Ontario's Geographical Referencing Program. John Kerr. (Applause)

ONTARIO'S GEOGRAPHICAL REFERENCING PROGRAM UPDATE

JOHN H. KERR, Manager
Geographical Referencing Services
Ministry of Natural Resources

Several years ago the Ministry of Natural Resources was given the responsibility to provide leadership in the development of a comprehensive geographical referencing system for the province, one which permits the correlation of different types of land-related data from a variety of sources. The first need identified was for a common reference framework to which topographic features, land parcels and other land-related data could be tied. To this end the Universal Transverse Mercator grid system, called UTM for short, was chosen as the official referencing grid for this province.

Next, a systematic series of accurate base maps on which thematic data could be plotted was required to display the grid and relate the map features to it. To meet this need the Ontario Basic Mapping system was designed and the OBM program was implemented in 1978 aimed at providing province-wide coverage by the mid-1990s.

Next, the need was recognized for a systematic approach to the whole issue of horizontal control surveys - these are the precise surveys that:

- give us the dimensions of the earth;
- relate the reference grid to the features shown on maps; and
- provide us with the precise latitude and longitude of monumented points on the earth's surface. (Those little brass plates you see imbedded in the sidewalk or roadway, are control survey monuments (see Fig. 1)).

Control surveys are the backbone of every geographically referenced land-related information system.

To systematize horizontal control in this province, the Ministry of Natural Resources, in co-operation with the Surveying and Mapping Industry, developed:

- the horizontal control survey multi-purpose analysis and adjustment program (MANOR),
- the Provincial horizontal control survey data bank (COSINE),
- the horizontal control survey network plotting program (MACSPLOT), and
- the specifications and guidelines for horizontal control surveys in Ontario called (OS79 and OG79).

MARKER ILLUSTRATIONS

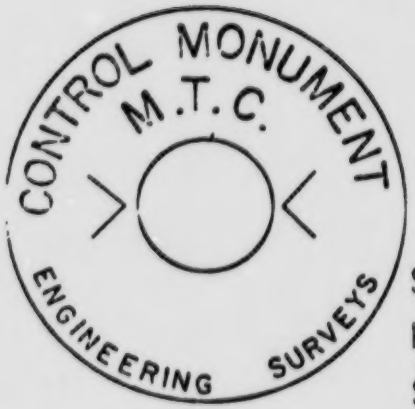

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Fig. 1

In addition, the Ministry is establishing 20 precise calibration baselines throughout the province. These baselines are used to calibrate electronic distance measuring devices before and after they are used on horizontal control survey and other projects in order to ensure the instruments are properly calibrated and are providing correct measurements. Two more of these baselines were established this year, one in Lindsay, one in Conestoga, bringing to seven the number established by the Ministry to date.

The Ministry has worked hand in hand with the Interministerial Committee on Geographical Referencing in developing and promoting these standards which also include a systematic series of grid cells (see Fig. 2) for those who reference their data to grid cells, and a point location identifier for those who reference their data to points. Both the system of grid cells and the point location identifier are based on the UTM grid.

Because of the need for some map users to computerize their land-related data in order to combine it with other data, for comparison and analysis, or to be better able to manipulate it or view it in a variety of forms such as reports (tables), graphs, or drawings, or view it on video screens from different aspects or at different scales, we investigated the computerization of the Ontario Basic Maps. Initial studies looked promising, however, before embarking on a full scale digital mapping program, it seemed prudent to first determine how different groups would use, and therefore impact the design of, a provincial digital topographic data base. Furthermore, since it had already been recommended at a previous geographical referencing seminar, that the Ministry play a role in identifying a generic land-related information system which municipalities could use, it appeared a user needs study would be required to provide much of the fundamental information needed. A proposal for the study was announced at a land-related information seminar which the Ministry hosted last year. Forty-seven municipalities responded to the invitation to participate. From these, four sample municipalities were selected - Mississauga, Cambridge, Woodstock and the County of Oxford. I would like to publicly acknowledge the spirit of co-operation of all four of these municipalities and indeed of the many provincial agencies interviewed and thank them for their time, efforts and co-operation. We arrived on short notice, took from one to several hours per interview and often asked for and received services including typing. Most people interviewed were kind enough to review and modify, where necessary, the interview reports and return them to us in a matter of days. This too was appreciated, without their help and co-operation, we could not have remained on schedule in order to be in a position to report back the results of the study this December.

In addition to discovering the "generic tools" that are required by different groups dealing with land-related information and how these groups would use a digital topographic data base, we were searching for the information needed to design municipal and provincial conceptual and functional models. The municipal models could be used by municipalities, as a guide, when designing local land-related information systems, and the provincial models could be used to show dependencies and relationships

A systematic series of grid cells based on the UTM grid

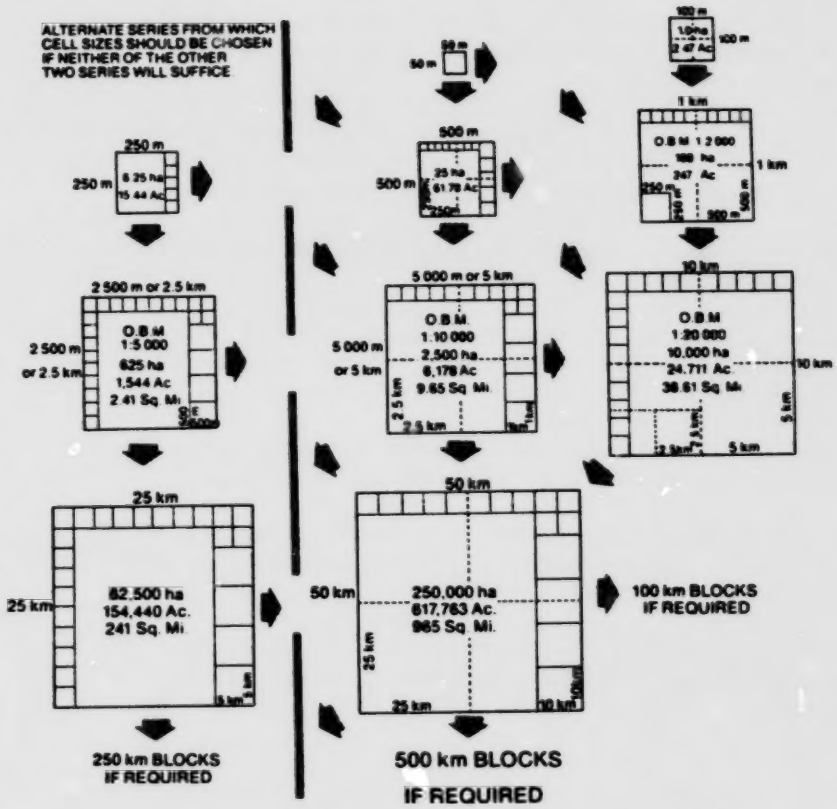

Fig. 2

between existing and proposed provincial land-related data bases. This would help in developing land-related information standards, programs and systems particularly those associated with a digital topographic data base.

Dr. Linders and Jack Dangermond will be talking about these models later on and, this evening, for those wishing to participate, Dr. Linders and Jack Dangermond will be co-hosting a workshop at which we hope with your participation to improve the design of these models and to resolve some issues in their design which have not been settled.

We started to design the municipal models in August after completing the Municipal User Needs Study, however, as we got deeper and deeper into the relationship that existed between municipal land-related activities and as we began as a group to more clearly understand these relationships, the models underwent considerable revision. The models we showed to the municipalities in October appear to be significantly different from those you will be seeing today, however, the relationships and dependencies are the same.

The study itself took longer than expected with almost 240 interviews being conducted instead of the 85 we had originally anticipated. More than half of the interviews took place in the municipalities.

Several interesting discoveries were made during the study, some of which I would like to share with you now.

- Although there is a need for digital topographic maps in municipalities, there is a far greater need for digital parcel maps.

- Most of the land-related information municipalities deal with is associated with land ownership parcels.

- A good deal of time is spent in manual searches of the land registry ownership records by both municipal and provincial personnel.

- There is a substantial exchange of many different types of data between the province and municipalities, for example: assessment, ownership, environmental, and resource data.

- Most municipal land-related information functions could be carried out on a digital parcel data base, the parcel co-ordinates of which could be created by simply digitizing existing land ownership parcel index maps.

With rare exception, the positional accuracy requirements of those interviewed were not high, this surprised us all. I believe this was one of the most significant findings of the study, but since four municipalities provided such a small sampling for such an important item, we decided to extend our sample base on this issue. To do so, we developed a questionnaire on positional accuracy requirements associated with parcel maps, and distributed copies to all municipalities in the province with

populations greater than 20,000. In addition, members of the Technical Advisory Committee particulary Jack Dangermond, have, over the past five months, been asking colleagues and personnel in municipal agencies from all over North America about this issue of positional accuracy. Jack will mention something about this later. Dr. Linders has reviewed and tabulated the results from the questionnaires which were returned before December 3, 1983 and will be reporting the results to us later on in the Seminar when giving his paper on digital parcel maps accuracy versus cost. You will all get an opportunity to add anything you wish on this matter of accuracy tomorrow afternoon during the Discussion Period. - In any event, it would appear the choice of how accurate the digital parcel maps should be, will ultimately reside with each municipality who themselves can balance off their accuracy requirements with the funds they have available to produce them.

In the long run, integrated surveys will tend to improve the positional accuracy of cadastral surveys. The Geodetic Committee of the Ontario Land Surveyors Association has recently completed a set of guidelines for integrating cadastral surveys to the horizontal control survey network (see Fig. 3). These will be incorporated into the Association's standards next year. The Ministry of Natural Resources is considering introducing integrated survey legislation in the not too distant future. As different areas of the province are deemed to be areas of integrated control, all new land surveys within those areas will have to be tied to the control survey network. This will provide UTM co-ordinate values for all the corners of these land surveys and inevitably we will have a mathematically defined cadastre suitably accurate for any application.

The Ministry of Consumer and Commercial Relations will receive the integrated plans of survey for registration and then pass the integrated station numbers and their corresponding UTM co-ordinates to the Ministry of Natural Resources for storage in COSINE. In this way, anyone about to perform either a control survey or an integrated cadastral survey in an area will be able to access COSINE via terminal over a telephone line and acquire all existing relevant control survey data and/or integrated survey data. Furthermore, it will ensure, and expedite, the readjustment of all integrated survey points in any area simultaneously with any horizontal control survey network being readjusted. It is our hope to stabilize the co-ordinate values, where possible, after the North American readjustment now scheduled for December, 1985.

Subsequent to completing the study and the draft municipal conceptual and functional models, we met with representatives from each municipality. We discussed briefly some of our findings as well as the recommendations the interviewers had made with respect to pilot projects in each area. We then proposed a specific pilot project for each municipality and invited each to participate. Because different groups such as Grand River Conservation Authority, Bell Canada, Union Gas, Ministry of Health, Ministry of Natural Resources and Ministry of Consumer and Commercial Relations were also interested in pilot projects in certain areas, the proposed pilot projects were drawn up in an attempt to do specific things in specific areas which could provide the greatest benefit to the largest group for the least cost. Barney Panting will have more to say on those projects tomorrow.

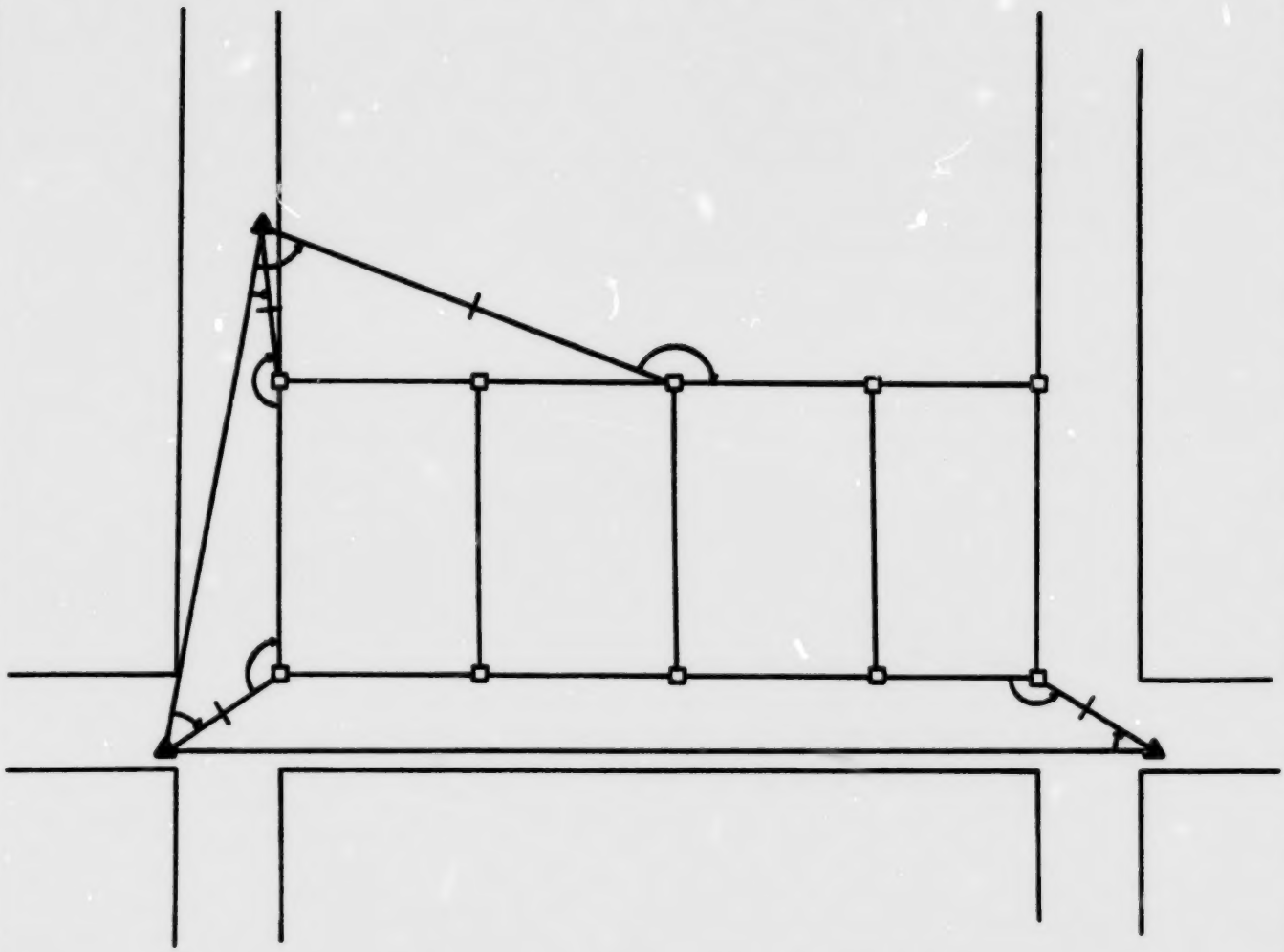

Fig. 3

While exceptionally pleased with the speed, efficiency and manner in which this study was carried out, I am sorry about the time it took to get copies of the final reports to the municipalities. While there were many reasons for the delay, it nevertheless was extremely inconvenient. We were also pleased that the municipalities were able to respond so quickly to the recommendations with respect to pilot projects. A rush here was necessary in order to identify the funding required for the pilot projects and the potential funding available so that, if necessary, an application could be made to the Provincial Government before the end of November in order to secure funds for the next fiscal year. The municipalities were engaged at this time in preparing their own budgets and if financial commitments were to be made by them for next year, they had to be submitted for approval in November or early December.

All interview reports are completed and with the exception of a few provincial ones, have been validated by those interviewed. Those we have back, have been put onto a word processor and are available on request at the cost of printing. We considered publishing them but because there is so much material and an unknown demand for the responses, we have not yet done so. There is a list at the Registration Desk which you can place your name and address on if you are interested in receiving a copy of either the municipal or the provincial reports. The interest level will dictate whether or not they will be published. If published, the reports will probably sell for $15 each, if generated from the word processor they will cost $50 each. In any event, an overview of the User Needs Study will appear in the Proceedings.

I should add in closing that we have prepared draft specifications for Digital Ontario Base Maps. These specifications have been distributed to industry and will be tested and enhanced, where necessary, prior to April 1, 1984.

CHAIRMAN PANTING: Thank you very much John. It is now 10 o'clock, we will break for about 20 to 25 minutes for coffee. We will see you back at that time.

****** COFFEE BREAK ******

There is an information board outside the door where you registered. Take a look at that board at noon hour and see if there is any message for you.

If some of those of you at the back of the room want to move forward, there are a few seats up in this general area.

Our next speaker, regardless of what your program says (laughter), is Mr. Alex Miller. Alex is Manager, Mapping Services with the firm of Marshall Macklin Monaghan here in Toronto. Well, Alex has many talents, not the least of which is his knowledge of computerized land-related information systems that are available on the market today. It was this talent that led to his membership on the Technical Working and Interviewing Group in the Ministry User Needs Study. And in his capacity on the User

Needs Study, Alex visited several North American production land-related information systems in order to become familiar with their capability, the quality of their products, and the services that they rendered. Mr. Miller received his Bachelor of Science and Engineering in Surveying Engineering from the University of New Brunswick. In 1979 he held various positions in surveying with the Ontario Ministry of Transportation and Communications and with Marshall Macklin Monaghan in the period of 1971 to 1974. As Manager, Mapping Services with Marshall Macklin Monaghan, Alex is responsible for various office and field operations within the Photogrammetry Department, including development of new software for analytical photogrammetry and digital mapping applications. Mr. Miller will give us an overview of several North American municipal land-related information systems. Mr. Miller. (Applause)

OVERVIEW OF SEVERAL NORTH AMERICAN MUNICIPAL LAND-RELATED INFORMATION SYSTEMS

ALEX MILLER
Marshall Macklin Monaghan

Thank you very much, Barney. As Barney has said, as part of the Municipal User Needs Study, representatives of the Technical Working and Interview Group visited four cities in North America that are considered to be at the forefront of geographical referencing in the municipal environment in Ontario and in the world. The purpose of the visits was to examine a number of state of the art systems that were operational and to examine them from a technical viewpoint, from the institutional contexts in which the systems were implemented and from a user's perspective. The four cities visited were Calgary, Alberta; Burnaby, British Columbia; Eugene, Oregon; and Milwaukee, Wisconsin.

Now, before I talk about each of these cities in detail, there are a few general points that are well worth mentioning about the four cities. Three of these cities' systems use turnkey CAD systems for property mapping. Specifically, Calgary and Milwaukee had Intergraph systems and Burnaby had a Synercom system. The other city, which was Eugene, Oregon, used Tektronix's CRTs tied to an IBM mainframe for their graphics. Three of the cities maintained large georeferencing data bases on IBM mainframe computers and the other city carried all of their attributes on a turnkey CAD system. All four systems used parcel ownership maps as the basis of their geographical information system. Two of the systems had parcel maps which were based on survey co-ordinates tied to control, very high accuracy co-ordinates, while the other two systems had parcel maps that were digitized from existing land records. Without drawing any conclusions, it is interesting to note that the two systems that had their co-ordinates tied to control were Canadian systems and the two systems that had their co-ordinates digitized from existing maps were American systems. All three IBM mainframes that were involved in these cities had data base management systems to maintain geographically referenced data bases on the mainframe systems. As I said earlier, the other systems used the turnkey CAD data base management facilities to manipulate their non-graphic data. Three of the systems began in the engineering department and the other one began in the planning department, and I think it is significant that the three that began in the engineering department were the three systems that were based on CAD systems.

Well, the first city I am going to talk about is the City of Calgary. Calgary's system is really three systems which are all linked together by various methods. The first system is a PDP11 based Intergraph system that is preparing legal base mapping and utilities mapping. Now Calgary is very lucky, and Edmonton is actually in the same position, in that the Province calculates all the co-ordinates of all property corners as part of the survey examination process. So co-ordinates for property corners that are calculated from surveys are available to all municipalities in the

Province. These co-ordinates are downloaded from the Province's computer to the Intergraph system at the City, and the City prepares a set of legal base maps from these co-ordinates. These legal base maps contain property lines, distances and bearings annotated on the plans. They are produced in a hard copy product at a scale of 1:1 000 on a 600x800 m format and there are 1,154 of these maps covering the City. After the legal base mapping is completed, the legal base maps are transferred over to a second Intergraph system which resides in the Data Processing Division of the Planning Department. The parcel polygons of property ownership are manually created from the legal base maps by pointing to the centre of a parcel and by using some fairly sophisticated software developed at Calgary which goes around and finds all of the lines that are associated with the outside of that particular parcel. Even so, it is a very time-consuming process. I did not mention how many work stations there are involved; there are eight work stations involved in the first Intergraph system and eight on the second Intergraph system as well, for a total of 16 work stations. The only thing common to both of these systems is the graphic representation of the parcels and a property identifier. All of the non-graphic information about parcels is maintained on a comprehensive geographical referencing system on the IBM mainframe and the system is called GRS. It is based on IBM's information management system which is a data base management system sold by IBM. But to make this particular data base management system work in a georeferencing environment, the City of Calgary has added an awful lot of their own code to it and in effect they estimate the amount of COBOL and PL1 code is somewhere near 500,000 lines of program code. So it is a very, very large system.

The communication between all three of these systems is by tape. The two Intergraph systems are in physically different locations and there is tape transfer between them. There is no real need for great speed, because one system is producing base maps and the second is using them as a basis to carry on. However, the transfer of information between the IBM and the second Intergraph system by tape has been a little bit cumbersome and they are hoping to develop some kind of a hard link in the near future.

The final point that I put down is the cost of Calgary's system, and this cost includes the cost of hardware, purchase of two Intergraph systems, the cost of developing all of their mapping and the cost of creating the georeferencing data base on the mainframe, and as near as I can tell is somewhere in the order of $75 to $100 per parcel in the City.

The second city that we are going to have a look at is the City of Burnaby. Now Burnaby is almost in complete contrast to Calgary in that the scope of the system is much smaller. I failed to mention earlier that Calgary has a population of, I think, about 600,000 people and about 130,000 parcels. Burnaby has a population of 140,000 and about 40,000 parcel, so it is a much smaller city as well.

Burnaby bases their entire system on the Synercom system. They maintain both the parcel, base maps and the related tabular data on the Synercom system. Again, the computer co-ordinates from legal descriptions and some from survey data, and in effect they have gone to great effort to tie these maps down very accurately. They have eventually tied between 25 to 30 property corners per map sheet to the control fabric. They produce a hard

copy map as well at a scale of 1:1 000 on a 800x500 m format and there are 260 of these maps covering the City. They do not have true polygons in their system. The properties are identified graphically and all of the tabular data is tied to a digitized centroid which resides in the system, approximately in the centre of the property. It is invisible, but a user just simply points to the centre of the property and is able to get tabular data associated with that property. They are adding zoning and planning data graphically on to the system and they are using it for a variety of studies including a Housing Compaction Study that Gabriella is going to talk about a little more. They are just beginning utility mapping in Burnaby. They see this as one of the greatest uses of the system and they have about 16 maps out of the 260 maps completed. Burnaby has managed to keep the cost of the system down to between $25 and $30 a parcel which is substantially cheaper than Calgary, and again this is a bit deceiving because Burnaby had no maps, no decent maps, before they started out. They justified bringing the system in on the basis of producing a high quality map series. The previous property maps they had dated back to 1939 or earlier, so the system more than paid for itself in the production of a new hard copy map series. The fact that they have a digital map simply is a bonus for them.

The third city we are going to look at is the City of Eugene, Oregon, and in fact the system in Eugene is not just the Eugene, Oregon system, it is the entire county of Lane County. Eugene and Lane County were in a rather unique position, in that they were a large county with a large population and decided to get into computing very early on in the computer age, in fact in the 1950s were using the computer for municipal information management. So they got a lot of support from IBM and as a result have done some very, very interesting things. Eugene maintains their entire geographic information system on an IBM mainframe; both their parcel tabular data and their related positional data. This is maintained on a data base as well and can be accessed from any one of 500 terminals throughout the City and the County. They use Tektronix digitizing tablets and Tektronix terminals and software created in-house to digitize parcel maps from existing tax maps. These maps have very low positional accuracy, there was no attempt to tie them to the control network at all, and in fact there are errors in the mapping of upwards of 25 to 30 feet. Not only do they have low positional accuracy, they also have very low quality graphics. There has been no attempt to clip off overshooting lines, lines that overshoot each other. They have just digitized each parcel as a polygon and put it into the system. It gives relative position to the parcel data. The system is used primarily as a planning tool. Engineering does not go near the system at all. Eugene use a variety of software packages; DMS is a data management system which was developed in Eugene in this period of time when IBM was giving them a large amount of support; CAP 2 is a COBOL architecture program which allows them to generate COBOL code with relatively simple commands. They use PLOT 10 Tektronix interactive graphics library as well as a system called Map Model which was developed at the University of Oregon which allows them to make queries of the tabular data base and then extract the associated parcels that belong to the parcels identified in the tabular query and SPSS, which is a statistical package. They do have a small engineering data base on a Wang 2200 and this is largely a stand-alone system that is connected to the main IBM computer via the phone lines, and co-ordinates that are generated on

the Wang as a result of subdivision applications are transferred over to the mainframe computer and it is Eugene's intention to upgrade these very low accuracy co-ordinates that they have with the co-ordinates from the Engineering Division whenever they can. As I mentioned earlier, one of Eugene's great strengths has been the strong support that they have received from IBM and Tektronix. Oregon is the home of Tektronix and in fact the Tektronix terminal that they have in there, the 481 series, has serial number 1, so they got the very first one from Tektronix. The system was also implemented in a unique institutional context. When computing came in to the County in 1950s, it was soon realized that no one particular municipality in the County could afford a computer all by themselves, so they all got together and developed an organization called the Lane Council of Governments. The Lane Council of Governments is an organization of municipalities within the County which at the beginning of each year establish the cost of computing, or what they feel is the cost of computing, and they all contribute towards this fund and then all computer usage for the entire year is free for all members in the Council of Governments. It has worked very well; they have expanded their capabilities every year and everybody seems to be fairly happy. As a result of implementing graphics and geographic information as part of administrative data processing, they have managed to keep the cost down to a very, very low level. In fact, the only thing that can be identified as real cost, over and beyond those of administrative data processing, is about $2.50 per parcel. So Eugene would have to be called a great success.

The fourth and final city was the City of Milwaukee, Wisconsin. Milwaukee is a city of about 600,000 people with about 160,000 parcel maps, and Milwaukee has an Intergraph system and in fact it is a very, very early Intergraph system. It was obtained back in the mid 1970s or late 1970s, when Intergraph was just getting started and in fact has only very recently had the processor upgraded and their work stations are still the very first generation of Intergraph work stations. They are using the work stations to generate parcel mapping by digitizing existing quarter section maps, legal maps and tax maps. They are maintaining a parcel data base, a tabular parcel data base on an IBM mainframe, using the ADABAS data base management system. There has been no attempt in the City to tie the maps to a co-ordinate control system, in fact, they have assumed the co-ordinate system which is (0,0) on the most southeasterly map sheet in the City and goes up at (1/2 mile, 1/2 mile) at the corner of each map sheet. So they have made a lot of assumptions about the original accuracy of the mapping, and in fact this has caused them some problems. They may have poor positional accuracy, but they have made very high quality graphic products. They have put a lot of effort into editing these maps, so they look very, very good. In hindsight, the people from Milwaukee say that this has been expensive, a very, very expensive exercise. One of Milwaukee's serious problems is that they have funded the system from a Federal Government block community development fund. They got the funding to establish initial systems and now that it is nearly complete and the time has now arrived to implement the system in the municipal environment, they find that they do not have as much support as they would like to have among the various departments in the City. This is in part because the system has been funded by the Federal Government and does not have the support of all of the Departments in the City that it could have. Another reason is really a unique institutional context in Milwaukee in that the City is

governed by 45 almost completely autonomous departments. They do not report to a CEO, they only report to the budget officer at the start of every year, so that is the only time they ever talk to each other. Because Milwaukee did not tie their parcel maps to the control system and digitized them from existing maps, they have managed to keep the cost down to a reasonable level, somewhere in the order of about $12.50 per parcel.

If we take a look at a comparison of all four cities and what they have done and what they are intending to do, we can see that all four cities have a parcel data base which has a positional element involved. Three of the four cities have a large tabular data base, and in fact Burnaby is in the process of implementing this right now through their Planning Department. Three of the four cities have developed a street network data base; in the United States, in particular, statistical data is available to large cities on a block face basis through the DIME files and they can really get a lot of mileage out of the DIME files by implementing a single line street network relatively inexpensively. Calgary has done the same with the Statistics Canada files. All four systems have an engineering data base to some degree or another and as I mentioned earlier, Lane County is on a separate small machine but it is still becoming an integral part of the complete system. Calgary and Burnaby are both planning to use their system for utilities mapping and are going to develop large utilities data bases, in fact, Calgary has managed to solicit the co-operation of nine major utilities and hope to actually finance the system ultimately from payments from the utility companies. Eugene has a non-graphic utilities data base. They have not loaded graphics in yet, but most of the information required on day-to-day maintenance of the utilities are stored on the mainframe computer. Milwaukee has not attempted to use the system for any kind of a utilities data base, they are using it extensively for capital works projects where they simply clip out a piece of the base mapping for producing plan profile and construction drawings. All four systems have planning data bases now involved with them, even though three of the systems began in the engineering side, the planning people that have been brought in are now great supporters of the system. And finally, none of them have a topographic data base. They all feel that this is ultimately a necessity but is not necessary to get going. It will eventually be part of a system in the future.

In summary, I would like to draw a few conclusions from the experience of visiting these cities. The most powerful and the most cost-effective applications are in planning in support for administrative data processing which revolves around the parcel base map. Now this does not mean that there are not very powerful applications in the engineering side, but the experience of the cities that we visited was that it was very expensive and it took a long time to get going. In fact, this is related to the common thread of advice that we got from every one of the cities: "to get results earlier". Do not spend years digitizing the maps and then suddenly appear five years later, after having spent several million dollars, and say we are ready to go. The rest of the city had forgotten that you were there. And finally, the main message was that very careful planning and very good management of the system implementation are very, very necessary to the success of these systems, otherwise the cost can just completely run away. Thank you very much. (Applause)

CHAIRMAN PANTING: Thank you very much, Alex. I have a note suggesting that we make some time available right now for questions relating to this particular paper. It comes from Jack Dangermond. And Jack did you want to speak about this? Are there questions? I have to assume, I must have caught you off guard after telling you there would not be any. The gentleman here. There is a mike at either side here.

Q: Ian Isaacs (EMR): Was Burnaby not based on the utilities kicking in a lot of money?

A: Alex Miller: Yes, the question was, was Burnaby not based on the utilities kicking in a lot of money. That is true, the Bell Telephone, I think B.C. Telephone and B.C. Hydro actually began to help fund the system, I don't think that they have got as much out of it as they were after. In fact, I know they got their own system. That is true.

Q: Bob McDonald (Northway-Gestalt Corp.): What kind of planning function was the most beneficial?

A: Alex Miller: The question was, what kind of planning function was the most beneficial? I think, all of them at the start were using them as a tool for improving their zoning. Milwaukee in particular is using theirs to check the by-law infraction. They have the land use, they have the zoned land use on the graphics system and they have the actual land use on the tabular data base as a result of assessments. They can compare the two and produce maps of conflicting land use. In fact, in Milwaukee they say that they will probably be able to pay for the entire system; they are going to increase taxation. (Laughter)

CHAIRMAN PANTING: Any other questions? Thank you again, Alex.

One of the several compromises that Surveys and Mapping Branch had to make in the conduct of the User Needs Study was to use a mixture of own staff and consultants on the Interview Teams, because the project as originally planned was underfunded. And this meant that a training and familiarization program had to be undertaken to raise the common denominator of familiarity with land-related information systems and their capability, and in addition provide for standardization of the interview process and documentation. Part of that training program was to visit and document the existing land-related information systems. Gabriella Zillmer, a member of the Technical Working and Interview Group in the User Needs Study, participated in system visitations and will address us on the topic "A Users Perspective on Municipal Land-related Information Systems Visited". Gabriella is an Honours B.A. graduate in Geography from Queen's University. While at Queen's, she was a Research Assistant from 1978 to 1981. In 1981 she came on staff of the Ministry of Natural Resources in the Geographical Referencing Services as a Data Processing Technician and Gabriella joined the User Needs Study at the beginning of the current year as a Research Technologist with the Technical Working and Interview Group. Gabriella Zillmer. (Applause)

A USERS PERSPECTIVE ON MUNICIPAL LAND-RELATED INFORMATION SYSTEMS VISITED

GABRIELLA ZILLMER
Geographical Referencing Services
Ministry of Natural Resources

Thank you.

The question that many people may be asking is "How have the four municipalities visited used or benefitted from the geographical information system that they have installed?". Perhaps by getting an answer to that question, one can better visualize the uses or benefits a municipality could realize through a G.I.S. Alex has clearly outlined the technical aspects of four North American G.I.S. in his paper. These four systems will be reviewed in this paper, however, they will be examined in the light of illustrating how the municipality used their system to aid in performing municipal functions.

CALGARY

In Calgary, the Engineering Department has completed data input for its legal base maps. The Data Processing Department uses these legal base maps for creating ownership parcel maps. The ownership parcel maps are used for a variety of functions including overlaying land use and zoning information. These overlays are used to validate that present and future land use is in accordance with Calgary's zoning by-laws.

The Engineering Department is currently creating utility overlays using the legal maps as a base. Utility data includes water, sewer, electrical, telephone, cable, etc. These overlays are reasonably accurate schematics that can be used by the Public Works Department and the utility companies as a visual reference. For example, in the case of an emergency, a query on these utility overlays for a particular location would identify which utility companies are to be notified.

In the future, Calgary hopes to have implemented the Calgary portion of what is termed the "Alberta One Call System". This system would permit someone to call in an address and be given all utility information for that address rather than having the individual call several companies to get the same information.

The Calgary G.I.S. makes extensive use of the Geographic Referencing System (GRS) to reference to existing data bases which are maintained by a variety of departments. Five location identifiers are used in the GRS. These include:

- street address
- building name
- legal description
- street intersection
- street segments

A user accesses data maintained in a particular department by keying in one of these identifiers. GRS will cross-reference to the location identifier required for data retrieval from the specific data file.

BURNABY

The City of Burnaby's Engineering Department has completed digital base coverage for the municipality. The digital base is used to overlay utility data. As with the Calgary example, these utility overlays are used as a visual reference by the Public Works Department and the utility companies in case of emergency situations. These overlays were not produced to provide engineering accuracy.

The Planning Department has used the digital coverage as a base for overlaying land use and zoning information. These overlays aid in the implementation of the municipal plan and validate that present and future land use is in accordance with existing zoning by-laws.

Burnaby also creates user specified tabular reports as required. These tabular reports are compiled by using Synercom software by querying parcel attribute files. At the moment, parcel attributes include parcel area, land use, percentage land developed, number of units in apartment complexes, street address and school, census and traffic codes. An example of the type of query that might be generated would be: To list all parcels greater than 4,800 square feet with commercial land use located within school zone 5. The system would compile and list all parcels fitting the criteria given.

As with the Calgary system, Burnaby uses its G.I.S. to cross-reference to existing data by keying in a location identifier such as address, co-ordinate or street intersection.

Burnaby has used their system to aid in at least two special studies. The first of these is the housing compaction study. This study was to identify areas within Burnaby where more residential development could take place. The City examined the ratio of lot width to lot depth, area of buildings to area of lot, and relative position of the house to the adjacent road. By comparing all of these figures, Burnaby determined which areas of the City could support added residential development.

A second special study undertaken by Burnaby involved the Advanced Light Rapid Transit project. A request was made by the Transit Department to produce a series of 1:500 scale maps of a 100 metre buffer area around a proposed transit route. The proposed transit route and its possible impacts could be more closely examined by employing these user specified maps.

EUGENE

In Eugene, contrary to the other municipalities, planning applications were the impetus for implementing a G.I.S. When the Municipal Government was faced with developing a 1990 General Plan to be revised every few years, the planners compiled and automated all relevant parcel data on their system. Once all of this data was on the system, revisions to the plan became much less time-consuming. In fact, the 2000 General Plan was completed in a matter of weeks rather than in the two years required previously. Low accuracy land use maps are used by the Planning Department to implement the General Plan by providing an automated means for validating that land use conforms to municipal zoning by-laws.

The Planning Department also generates user specified tabular reports and low accuracy digital maps for a variety of planning studies. The planners aggregate and correlate graphic and non-graphic parcel data from a variety of departments to provide tabular reports or listings of user specified parcel attributes, much the same as with the Burnaby case. These tabular listings can be supported by a low quality digital map product which identifies parcels or areas in question.

The parcel data maintained by Eugene is updated daily. All permits (including building permits, demolition permits, parade permits, etc.) are processed using the G.I.S. with terminal access. A permit application is entered on-line as it is received and updates all necessary files automatically. Everyone is thus assured of having access to the most current data. As is demonstrated by the 500 terminal access and the daily use of the G.I.S., the Eugene/Lane County system is very user-oriented.

Again, as with Calgary and Burnaby, Eugene makes use of a cross-referencing mechanism called Geographic Data System (GDS) to access existing data which is located in various municipal departments by keying in one of several location identifiers.

The Eugene system has been used to undertake a variety of special studies. The police have used the system to help identify high crime areas by compiling and automating crime incidence data by location. Identification of high risk areas aided in allocating more police officers to these zones.

Transit planners have used the Lane County G.I.S. to route buses to areas requiring transit service. Population, age of population, income and other demographic data was used in conjunction with street network data to determine areas requiring transit service. Efficient routes through these areas were also developed using the G.I.S. optimal path selection capabilities. Transit planners used similar data to determine the optimal location for bus stops along the transit route.

Fire authorities have also used the G.I.S. to their advantage. In planning a new site for their fire hall, the department examined population, distance and street network data. Time - distance districting helped to determine the optimal location for the fire hall. Distance to all locations where fires could occur in the vicinity of the fire hall have now been minimized. Fire hazard areas are also identified by aggregating and

correlating data such as type of building, age of building, material building is made of, distance from next building, etc. These fire hazard areas, once identified, can be appropriately serviced by the Fire Department in the event of an emergency by using the area information used to initially identify the fire hazard areas.

The Eugene system was also used for a project called the South Hills Development Study. Since the land for this project was located in an area of steep hillsides, the G.I.S. aided in examining all of the development constraints associated with the site. The constraints were examined and evaluated by developers who subsequently built the subdivision while keeping in mind and working around possible hazard areas.

MILWAUKEE

The Engineering Department in the City of Milwaukee completed a digital quarter section base map and a street segment file. The Planning Department used this quarter section base to overlay land use data. Again, this was used largely to validate that present and future land use conformed to zoning by-laws.

The system was also used to aid in re-establishing voting ward boundaries. Voting wards are balanced by population which involved a process requiring $60,000 and 4-6 man-months of effort. In 1980, using the capabilities of their G.I.S., the City of Milwaukee redrew their voting zone in only a few weeks for a cost of $25,000.

Milwaukee has produced a number of highly visible graphic products which have helped to keep the G.I.S. project on a high priority level with City politicians. One of these was a parcel map symbolizing the status of building inspection activity in a particular neighbourhood. The symbols illustrated buildings that had been inspected and passed, buildings that had been inspected and had outstanding violations, etc. A politician took these graphics to a neighbourhood meeting and could very easily explain to the citizens what type of City inspection activity was being carried out in their community.

Other graphic products that the municipality developed over the course of the project are a series of choropleth maps. U.S. census data and data collected by the City were linked to street segments in the street segment file. By aggregating the data in user specified classifications, the City was able to produce a number of thematic maps. For example, when Milwaukee wanted to embark upon a mortgage subsidy program, they created a thematic map illustrating the percentage of mortgage owing to banks. The politicians could readily see which areas required a bulk of the mortgage subsidies. Milwaukee has generated a number of these choropleth maps including one illustrating percentage o[illegible]cial groups in certain areas and another indicating percentage of owner occupied housing, etc. Once the data has been automated, thematic or choropleth maps can be generated in one day.

Several of the choropleth maps for the 1980 census information have been compiled and published as an urban atlas for Milwaukee. Politicians,

students and municipal administrators use the urban atlas as a valuable information source.

As in Calgary, Burnaby and Eugene, the City of Milwaukee uses a cross-referencing mechanism to access a number of parcel data files.

In conclusion, one can see that although a number of these applications are common to all four systems, such as cross-referencing, validation of land use, etc., each municipality has also proceeded to structure their G.I.S. to fit the unique needs of their community. It is important to realize that the potential for the uses of a G.I.S. are limited only by one's imagination.

CHAIRMAN PANTING: Thank you very much, Gabriella.

Our next speaker is Mr. Jack Dangermond as a Founder and Director of Environmental Systems Research Institute of Redlands, California. Jack has a great deal of experience in developing urban and state geographical referencing systems and is known in the United States as the guru of G.I.S. Jack is also at the far end of John Kerr's 3,500 miles tether that binds the User Needs Study Technical Advisory Committee together and as the principal architect of the User Needs Study, who is in a better position to address the next topic: "The Methodology Employed in the User Needs Study". Mr. Jack Dangermond. (Applause)

ONTARIO USER NEEDS STUDIES

A DESCRIPTION OF THE PROJECT METHODOLOGY

AND ANALYSIS PROCEDURES

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ABSTRACT

This paper presents a description of the process which was undertaken and the methodology which was employed in carrying out the Ontario User Needs Studies. These studies addressed the existing capabilities, potential needs and desires, and perceived system requirements regarding land-related information systems for municipalities and provincial agencies in Ontario. The Ontario User Needs Studies provide an example of the methodology and procedures involved, and the types of results which may be obtained.

BACKGROUND

The Ontario Ministry of Natural Resources has been involved in geographic referencing activities since 1974, when it was given the mandate to develop a comprehensive system permitting correlation in an efficient and visual manner of the physical properties, legal status, resources and use of lands in Ontario. Since this mandate was established, the Ministry has been involved in developing and specifying many standards and components within such a system, including control survey standards, a control survey data bank, programs for survey adjustment, analysis and network design, mapping and so forth.

As its activities in geographical referencing evolved, the Ministry developed an awareness of the capabilities of various digital mapping systems in North America. However, the Ministry did not have a means for gaining clearer understandig of how these systems could accommodate municipal and provincial needs in Ontario.

The impetus to pursue these questions was provided to the province during Geographic Referencing Seminars in 1981 and 1982. During these seminars, it was recommended that the Ministry play a role in identifying a generic land-related information system which municipalities could use.

In pursuing this role, several questions needed to be resolved:

1. What land-related data and system capabilities are needed by the municipalities in Ontario?

2. How could municipalities use a provincial digital topographic data base?
3. How could the exchange of land-related data between the province and various municipalities be facilitated?
4. In view of the technologies available, what direction should be taken for implementing effective digital mapping systems at the provincial and municipal levels?

With these questions in mind, the province proposed to undertake the Ontario User Needs Studies. The study was generally directed toward: the identification of land-related information, its uses and requirements in the province and representative municipalities; the clarification of relationships or dependencies among data and its users; and the specification of data and data management tools which need to be developed or enhanced.

GENERAL PROJECT APPROACH

A systematic approach was followed to initiate and conduct the Ontario User Needs Studies. The approach incorporates concepts definition of user requirements, system options, and the testing or advisability of various alternatives are then pursued.

Essentially, the user needs studies at the provincial and municipal levels were envisioned as one of several phases in the Ministry's efforts to understand and translate information regarding land-related information system needs in Ontario. The larger project effort was conceived to include the following components:

1) Conduct a seminar on provincial and municipal integration regarding land-related information systems to inform both municipal and provincial representatives of the capabilities of current digital mapping and land-related information technologies;

2) Carry out the municipal and provincial user needs studies;

3) Establish and describe conceptual models of data dependencies within the province and individual municipalities;

4) Develop a functional model which describes a suggested data structure and requirements within municipal data entities; and

5) Consider pilot projects to further explore and clarify the potential and characteristics of municipal and provincial land-related information systems.

Each of the latter three project initiatives were considered on an ongoing

basis during the course of the provincial and municipal user needs studies. The seminar, on the other hand, provided broad-based direction and advisory input into the studies as they got under way.

In specific regard to the user needs studies, which are the focus of this paper, several steps were undertaken:

Project Design and Planning

1. Definition of Project Objectives
2. Staff Organization and Support
3. Selection of Municipal and Provincial Agencies for Project Participation
4. Interview Design, Preparation and Training
5. Selecting and Scheduling of Interviews

Data Gathering and Analysis

6. Completion of Interviews and Report Preparation
7. Identification of Information Needs and Uses
8. Evaluation of Existing Information Resources

Preparation of Materials for Developing Provincial and Municipal Data Models

9. Synthesis of Conclusions for Conceptual and Functional Model Development

In the following pages, each of these steps will be described.

Project Design and Planning

The project design and planning phase encompassed all of the preparatory work and training which preceeded actual data gathering and report preparation. The steps involved took place over approximately a two-month period early this year, and encompassed:

- Definition of Project Objectives
- Staff Organization and Support
- Selection of Municipalities for Project Participation
- Interview Design, Preparation and Training
- Selection and Scheduling of Interviews

1. Definition of Project Objectives

While objectives of the study were specified at the outset, they were also reconsidered in an iterative manner as the project evolved. The municipal

user needs study was directed toward achieving the following objectives:

Municipal Study Objectives

- To ascertain user requirements by examing existing procedures and practices in terms of data sources and their users.
- To identify system tasks and functions with the aim to synthesize a model of how each data component within the organization is expected to function.
- To establish dependencies which exist among organizational tasks and types of data, and to identify the sources and characteristics of these data.
- To determine the potential applicability of geographic data management procedures to municipal tasks and activities and to identify existing and potential relationships between municipal and provincial agencies for developing and sharing land-related data.

In undertaking the provincial interviews regarding user needs, the objectives were somewhat related to - yet distinct from - those of the municipal effort. The provincial objectives may be synthesized as follows:

Provincial Study Objectives

- To identify cross-cutting data sources and needs within provincial agencies.
- To clarify the existing and potential relationships between municipal and provincial agencies for developing and sharing land-related data.
- To identify provincial systems which could impact the design or utilize a digital topographic or digital parcel data base.
- To determine the potential applicability of particular geographic data management procedures to provincial data systems and related tasks.

2. Staff Organization and Support

To carry out the user needs studies, individuals were selected from Ministry of Natural Resources staff and numerous private consulting organizations involved in the survey and mapping industries. A Steering Committee was established to guide the effort. This Committee, chaired by the Provincial Surveyor-General, was composed of municipal representatives and provincial ministries which use land-related information. A Technical Advisory Committee (TAC), comprised of Jim Linders and myself, was also established to advise John Kerr, the project manager, as well as the Technical Working and Interview Group (TWIG) and the Steering Committee. TAC and TWIG have met periodically throughout the past year. During joint TAC and TWIG meetings, the products of interviews were reviewed, the

CONCEPT PAPER

Background

The Ministry of Natural Resources was given the responsibility in 1974 to develop a comprehensive system which permits the rapid and visual geographic correlation of the physical properties, legal status, resources and use of the land in Ontario.

To date several standards and components of the comprehensive system are in place, others are under development. We are aware of several components that we have not yet started to work on and no doubt there are some that we simply, as yet, know nothing about.

In place are such things as provincial horizontal control survey standards and guidelines, the provincial horizontal control survey data bank, a horizontal control survey adjustment, analyses and network design program, a program for plotting control survey networks and a program for converting co-ordinate values from one system to another.

The Universal Transverse Mercator Grid System has been adopted as the official provincial geographical referencing grid. A systematic series of grid cells structured on the UTM has been defined for those who reference their data by cells. A point location identifier in UTM format is also in place.

The Ontario Basic Mapping system is yet another fundamental component of the comprehensive system. The mapping program is well under way and total provincial coverage is expected by the mid-1990s. These standards and components of the comprehensive system are being developed and promoted to help everyone in this province who deals with land-related information. If adopted and used, many of the correlation problems will disappear and data will be much more available and useable than it would be otherwise.

Maps are fundamental to almost all land-related information systems. Some information systems in fact are structured on digital maps. The Ministry has been aware of the growing use of digital maps in North America and has kept abreast of the capabilities of the more promising systems. We have even developed a pilot system to determine first-hand what can and cannot be done with this technology. We are to some extent aware of the strength and weaknesses of these systems for several provincial applications, but we know little about their capability to meet municipal needs.

At a Geographical Referencing Seminar sponsored jointly by the Ministry of Natural Resources and the Interministerial Committee on Geographical Referencing held at Queen's Park last year, it was recommended that the Ministry play a role in identifying a generic land-related information system which municipalities could use. We agreed to get involved because of the apparent need to ensure some degree of compatibility in these systems as they evolve across Ontario. In order to determine what such a system is required to do we have to know what the potential users want. We are therefore embarking on a user needs study early next year. The scope of the study was intended to cover the sixty or so geographical referencing systems in the provincial government and a good cross-section of municipalities.

Figure 1

Unfortunately in light of the present economic conditions and fiscal constraints we will not have the financial resources originally hoped for and therefore must focus our attention on considerably fewer municipalities than originally intended. An in-depth study will, however, be made of three provincial municipalities: one with a population over 500,000, one with a population between 75,000 and 500,000 and one with a population under 75,000.

This will be followed by the preparation of a functional specification outlining what has to be done and then a feasibility study to determine how best to meet those needs.

From this initial phase we will develop a conceptual design for a land-related information system for your municipality including how the system relates to digital Ontario Basic maps, POLARIS and other provincial systems which are of interest to you.

To assist us in determining which three municipalities should be studied we are distributing the attached response form to all municipalities in Ontario with populations of over 20,000. We want your municipality to indicate its level of interest and what cooperation and participation it is prepared to render if it is chosen for the study. We expect your proposals to be returned to the Surveyor General's office, Room 6602 Whitney Block, Queen's Park, Toronto(M7A 1W3) by February 1st, 1983, at which time they will be reviewed and three municipalities selected for the study. The selection will be based on what is felt to be the best alternatives for ensuring the funds we have available will effectively complete the user needs study, permit the preparation of a functional specification and complete the feasibility study which includes a review of the capabilities of any candidate systems.

The meeting will bring in expertise to perform or help in performing the initial conceptual analysis of your municipal operations including how Ontario Basic Mapping relates to your data. We will also look at other aspects of the geographic data linkages, data base networks for positionally related data, thematic mapping, your land records and the kinds of problems for which people seek answers from these records.

We will assist you in looking at the overall picture and in coming up with some conceptual solutions.

Through this study we expect in addition to the things already mentioned to determine what role digital Ontario Basic maps are expected to play in both provincial and municipal information systems. We will also identify which if any existing system appears to most closely meet the user needs.

Figure 1 (continued)

MUNICIPALITY RESPONSE

MUNICIPALITY: _____ Population _____

Address: _____ Telephone _____

_____ Postal Code _____

_____

Number of Departments _____

CONTACT: _____ Telephone _____

Department: _____

Address: _____

_____

_____ Postal Code _____

		YES	NO	DON'T KNOW
1.	Currently have Digital Mapping Facility	___	___	___
2.	Currently have computerized alpha/numeric land-related information system.	___	___	___
3.	Prefer municipal and provincial land-related information systems be compatible.	___	___	___
4.	Currently have a committee of representatives from different departments of your municipality who have been studying how to implement a LRIS and who could serve as liaison group between municipality and MNR staff and consultants performing a user needs study.	___	___	___
5.	Could provide two people to work with MNR staff and consultants in carrying out the User Needs Study	___	___	___
6.	Could provide one person to work with MNR staff and consultants in carrying out the User Needs Study.	___	___	___
7.	Could not spare anyone to work directly with MNR staff and consultants on a user needs study, but will provide a contact person who will direct MNR staff and consultants on who to talk to and schedule appoint-ments.	___	___	___

Figure 1 (continued)

	YES	NO	DON'T KNOW
8. Cannot provide staff to assist MNR staff or consultants with a user needs study but are interested in having such a study made in our municipality.	___	___	___
9. If a system was available which demonstrated a significant benefit/cost saving would you be prepared to implement it?	___	___	___
10. Are you interested in a document which would outline those things that a municipality should do in preparation for the implementation of a Land-related Information System?	___	___	___
11. Is the 1:2000 scale Ontario Basic map in digital form relevant in meeting some of your requirements?	___	___	___

If yes, identify potential application areas:

12. Would you share the cost of a user needs study for your municipality on a 50/50 basis with the Ministry of Natural Resources?	___	___	___

13. In addition to any resources stated above we are prepared to do the following, if our municipality is chosen for a user needs study: (Use overleaf if necessary.)

14. The qualifications of the staff we are prepared to provide to assist in the study are:

Figure 1 (continued)

results were analysed and summarized, and data models were discussed and designed.

3. Selecting of Municipalities and Provincial Agencies for Project Participation

During the seminar on land-related information systems, sponsored by the Ministry of Natural Resources in December, 1982, an invitation and questionnaire regarding participation in the user needs study was presented to the municipalities in Ontario. A copy of the questionnaire which was used is included in Figure 1.

Using this questionnaire, municipalities were selected, based upon the following:

- Willingness to participate in and support the study,
- Capability to provide staff with relevant expertise,
- Capability to provide typing support services,
- Desire to be involved in subsequent pilot projects and system implementation activities, and
- Other factors.

The municipalities selected to participate in the municipal study were Woodstock, Oxford County, Cambridge, and Mississauga. These study areas represent a range in size. The City of Woodstock, for example, covers approximately 2,300 hectares with a population of 26,000, while the City of Mississauga covers approximately 28,700 hectares, and contains a population of an estimated 325,000 persons.

The selection of provincial agencies to interview during these studies was determined by the TAC, TWIG and Steering Committee groups, in conjunction with provincial agency representatives on the Interministerial Committee on Geographical Referencing.

4. Interview Design, Preparation and Training

After the four municipalities to be involved in the study were chosen, a team of interviewers needed to be selected and trained to effectively gather study data. Two-person teams were designated to conduct the interviews for each municipality.

Training for the Technical Working and Interview Group (TWIG) involved introducing and elevating the group's comprehension regarding system capability through exposure to existing operational systems, their products and services. In particular, training consisted of: familiarization with current tools and techniques associated with land-related information systems; training methods for observing systems and interviewing personnel; a review and tour of existing land-related information systems in: Calgary, Alberta; Burnaby, B.C.; Lane County, Oregon; Milwaukee, Wisconsin; and Metropolitan Toronto; and co-ordination and briefing in regard to the procedures to follow in reporting upon municipal interviews.

The format and content of interview reports were then discussed and refined. In order to accurately and specifically document the interviews, a format and check list was prepared, which is contained in Figure 2, and describes the information designated for the reports. Figures 3 and 4, respectively, provide illustrations of the data source sheet and matrix of geographic data management procedures. These were to be completed for each interview where relevant data sources or tasks were identified.

An interview guidelines memo was also distributed to detail the types of questions which were to be pursued in the interviews, as shown in Figure 5.

5. Selection of Interviews to be Conducted

The municipalities and provincial agencies participating in the user needs study each provided a contact person who, in co-ordination with MNR staff, prepared lists of all departments, groups and individuals to be interviewed. These lists contained the following information: Department names and representative's names, addresses and telephone numbers.

These lists were considered and discussed by the Technical Advisory Committee (TAC) and Technical Working and Interviewing Group (TWIG), to assure inclusion of all relevant organizations which develop or use land-related information.

Once the selection of interviews was completed, briefing sessions were scheduled, during which the MNR project manager and interview team met with the department heads and relevant personnel to be interviewed. These sessions provided an opportunity to introduce the project and its goals, as well as participating personnel, to municipal staff representatives.

The types of departments selected for interviews in municipalities included the following:

- Engineering and Works Department
  - Survey Capital Works
  - Maintenance
  - Engineering Projects
  - Engineering Planning
  - Drafting
- Building Department
  - Enforcement Services
  - Zoning/Adjustment
- Planning Department
  - Policy Planning
  - Current Planning
  - Urban Design
  - Drafting
- Community Services Department
- Recreation and Parks Department
  - Parks and Arenas

TABLE OF CONTENTS FOR FINAL REPORT OF USER NEEDS STUDY

1. User Agency Description (Executive Summary)

1.1. Ministry of Natural Resources
- General Responsibility and Organization Description
- Divisions

1.1.1. Division
- Organization/Responsibility/Purpose
- Systems (Manual/Automated)

1.1.1.1. System 1 (e.g. F R I)
Name of Staff Interviewed
System Description - Written Description
Tasks - Flow Diagram
- Data Management Procedures Chart
- Data Summary Chart

Software/Hardware
Benefits/Problems
Needs/Wants

1.1.1.2. System 2

1.2.

2. Available Data
3. Conceptual Design
4. System Environment (Hardware/Software Management)
5. Implementation Plan

Figure 2

DATA SOURCE INFORMATION SHEET

TITLE:

SOURCE AGENCY:
PERSON:
TITLE:
ADDRESS:

PHONE:

DESCRIPTION:

FORMAT:

	M	A	MEDIA
MAP			
TABULAR			
IMAGE			
TEXT			
LIBRARY			

NOTE:

SCALE:

ACCURACY/RESOLUTION:

SIZE/VOLUME:

GROWTH RATE:

DATA ITEMS:

RETRIEVAL KEY(S):

GEOCODE:

DATE OF CREATION:

FREQUENCY OF UPDATE:

COVERAGE/COMPLETENESS:

SOURCE OF INFORMATION:

USERS OF INFORMATION:

VOLUME/FREQUENCY OF USE:

ACCESS METHOD FOR USER:

AVAILABILITY:

CHARGES:

HARDWARE AND LOCATION:

SOFTWARE:

NOTES (PROBLEMS, DEPENDENCIES, ETC.)

Figure 3

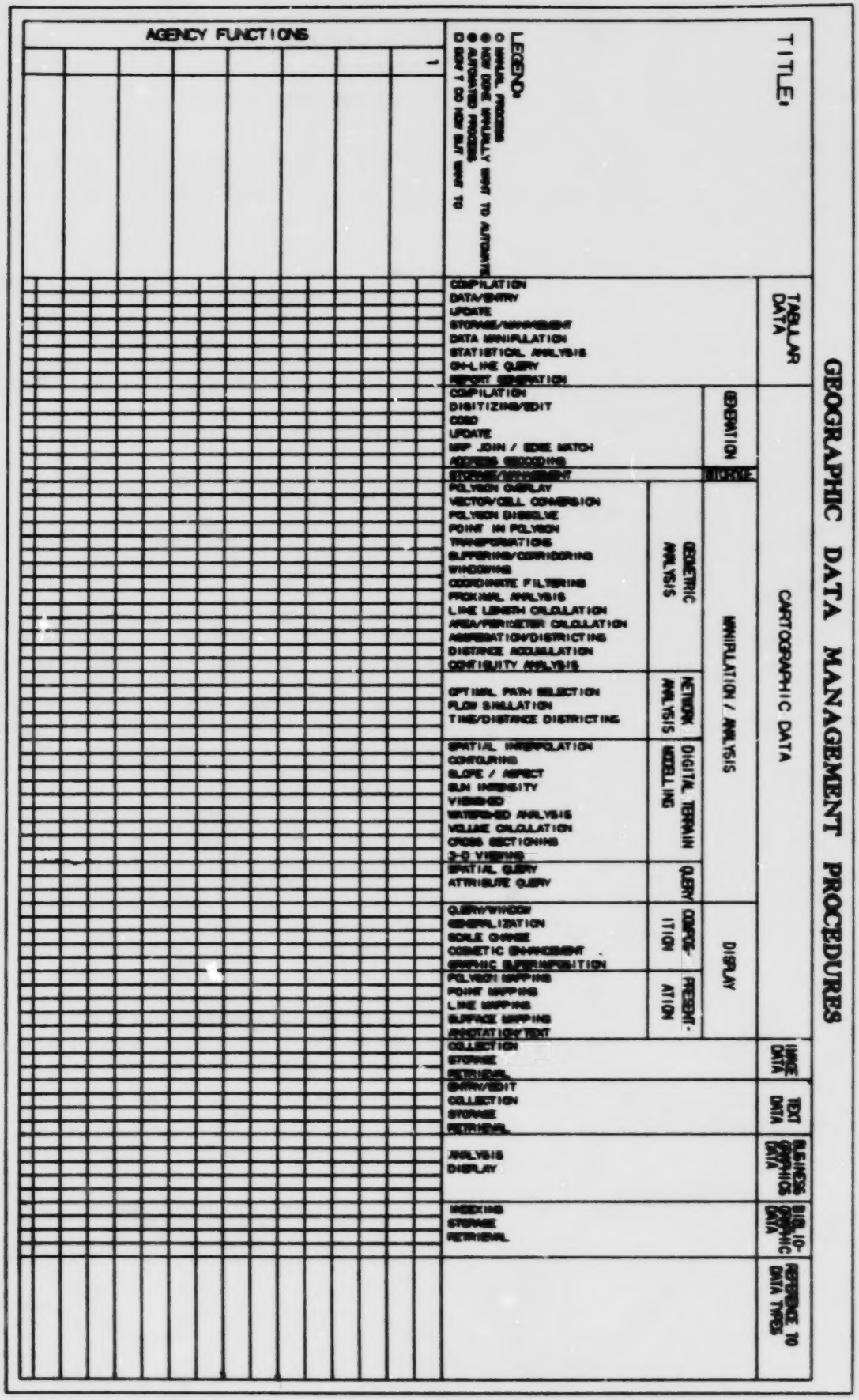
GEOGRAPHIC DATA MANAGEMENT PROCEDURES
TITLE:
AGENCY FUNCTIONS
1
LEGEND:
O MANUAL PROCESS
● NOT DONE MANUALLY WANT TO AUTOMATE
● AUTOMATED PROCESS
□ DON'T DO NOR BUT WANT TO
TABULAR DATA
COMPILATION
DATA ENTRY
UPDATE
STORAGE/MANAGEMENT
DATA MANIPULATION
STATISTICAL ANALYSIS
ON-LINE QUERY
REPORT GENERATION
CARTOGRAPHIC DATA
GENERATION
COMPILATION
DIGITIZING/EDIT
CODD
UPDATE
MAP JOIN / EDGE MATCH
ADDRESS GEOCODING
STORAGE/MANAGEMENT
MANIPULATION / ANALYSIS
GEOMETRIC ANALYSIS
POLYGON OVERLAY
VECTOR/CELL CONVERSION
POLYGON DISSOLVE
POINT IN POLYGON
TRANSFORMATIONS
BUFFERING/CORRIDORING
WINDOWING
COORDINATE FILTERING
PROXIMAL ANALYSIS
LINE LENGTH CALCULATION
AREA/PERIMETER CALCULATION
AGGREGATION/DISTRICTING
DISTANCE ACCUMULATION
CONTIGUITY ANALYSIS
NETWORK ANALYSIS
OPTIMAL PATH SELECTION
FLOW SIMULATION
TIME/DISTANCE DISTRICTING
DIGITAL TERRAIN MODELLING
SPATIAL INTERPOLATION
CONTOURING
SLOPE / ASPECT
SUN INTENSITY
VIEWSHED
WATERSHED ANALYSIS
VOLUME CALCULATION
CROSS SECTIONING
3-D VIEWING
QUERY
SPATIAL QUERY
ATTRIBUTE QUERY
DISPLAY
COMPOSITION
QUERY/WINDOW
GENERALIZATION
SCALE CHANGE
COSMETIC ENHANCEMENT
GRAPHIC SUPERIMPOSITION
PRESENTATION
POLYGON MAPPING
POINT MAPPING
LINE MAPPING
SURFACE MAPPING
ANNOTATION/TEXT
IMAGE DATA
COLLECTION
STORAGE
RETRIEVAL
TEXT DATA
ENTRY/EDIT
COLLECTION
STORAGE
RETRIEVAL
BUSINESS GRAPHICS DATA
ANALYSIS
DISPLAY
BIBLIOGRAPHIC DATA
INDEXING
STORAGE
RETRIEVAL
REFERENCE TO DATA TYPES

Figure 4

INTERVIEW GUIDELINE

Begin with an explanation of the purpose of the interview.

1. ORGANIZATION:

   (i) Briefly summarize the purpose of the organization.

   (ii) Obtain or draw an organization chart.
   - size and allocation of personnel.

   (iii) Organizational context (i.e. an overall view of where this group fits into organizational chart in general).

   (iv) Be aware of, but do not ask, history and context of organization.

2. WHAT DO YOU DO?

   (i) What is your mandate? Responsibilities? (At this point you may ask for policy and procedure manuals, legal mandates.)

   (ii) What are services provided?

   (iii) What are products produced? (This leads into work flow.)

   (iv) Work flow of agency department.
   - look at costs, volume, person/year allocations, dependencies within work flow.
   (The interview drives this, i.e. interrupt, draw out, lead interview.)

3. DESCRIPTION OF EXISTING SYSTEMS

   DATA:

   (i) Data type, i.e. map/file/air photo, etc.

   (ii) Data base characteristics (see form)
   Environment: manual vs machine

   (iii) Flow of data — how data passes through system.

   (iv) User interface — i.e. how user accesses data (over counter, terminal, etc.)

   (v) How data is used.

   HARDWARE:

   (i) Kind of machines system runs on or cabinet; description of type of environment.

   (ii) Touch base with data processing managers — to describe city "X" and their constraints due to existing hardware
   - type of computer and peripherals
   - number of personnel
   - type of operating system environment.

Figure 5

DIGITAL/SOFTWARE

MANUAL/PROCEDURE:

(i) Type of packages used, i.e. in-house developed, purchased packages

(ii) DBMS employed

(iii) Graphics packages, i.e. tektronics

(iv) Analysis packages

(v) Specialized systems, i.e. building inspection, etc.

BENEFITS AND PROBLEMS:

(i) Cost savings)
(ii) Efficiency) Benefits
(iii) Capability)

(iv) Bottlenecks

(v) Software

(vi) Resource - People)
- Hardware) Problems
- Space)
- Money)

4. NEEDS AND WANTS

(i) Are doing — data, analysis

(ii) Should be doing — increased capability, i.e. expansion + improvement of flow; expansion of system.

(iii) Would if could — guidelines
— replacement/redo

(iv) Data Requirements

(v) Analysis capability, i.e. polygon overlay.

(vi) Hardware and equipment, i.e. plotter.

Figure 5 (continued)

- Recreation and Transit
- Co-ordination of Development
- Transit Department
- Treasury
- Clerks/Administrative Services
  - Clerks
  - Data Processing
- Fire
- Ambulance Service
- Business Development
- Information and Public Relations
- Utilities
  - Hydro
  - Gas
  - Telephone
  - P.U.C.

At the provincial level, interviews were to be conducted in the Ministries of Agriculture and Food, Citizenship and Culture, Consumer and Commercial Relations, Environment, Government Services, Health, Municipal Affairs and Housing, Natural Resources, Revenue, Tourism and Recreation, as well as the Chief Election Officer, Ontario Hydro, and the Ontario Provincial Police.

One to two-hour interviews were subsequently scheduled to take place over a period of several months.

6. Completing Interviews and Reporting Findings

During the project, representatives of all relevant organizational units were interviewed. In addition, samples of maps, reports, forms and other pertinent materials were obtained for further understanding of municipal activities.

The information which was gathered during the interview process was summarized in various forms (most of which will be illustrated in this paper). These forms were useful both for recording the data and for subsequent analysis in creating conceptual and functional models of municipal data dependencies and relationships.

An example of the results obtained from this interviewing process is useful in demonstrating how relevant information was identified and reported in this process. This is presented in Case Example 1 which follows:

Case Example 1

CITY OF CAMBRIDGE

ENGINEERING DIVISION
TRAFFIC SECTION

Organization and Responsibilities

The major responsibility of the Traffic Section is to ensure the safe and efficient movement of pedestrian and vehicular traffic throughout the Municipality. Implicit in this responsibility are the tasks of traffic control, crossing guard provision, street lighting, etc. A staff of one currently performs the tasks required to fulfill this responsibility.

Tasks/Systems

1. Collision and Traffic Aanalysis

The Regional Police maintain records of all accidents in the Region. This information is provided to the Municipality on a monthly basis in the form of a hard copy report. There are also quarterly and annual print-outs. These reports are used to identify potential problem locations. Information is available as to the type of accident, conditions under which it occurred, as well as severity. This information is used to identify trends and patterns, such as impediments to visibility.

The rationale behind the collision reporting is to attempt to anticipate potential problem areas, which may often be overcome by changing the control sequence. For example, a yield sign could be replaced by a one-way stop sign at a problem location. If this fails, a stop sign may be installed on all four corners. Finally, if this fails and traffic volumes are high, a traffic light will be installed.

2. Traffic Volume Analysis and Traffic Flows

Another major activity of this Section is to examine traffic volumes and flows in the Municipality. In order to collect the information, traffic counters are installed on local roads. There are two types of traffic counters: automatic traffic counters and manual traffic counting procedures. When manual counting techniques are used, the information is measured over an eight-hour period by summer students. The advantage of an automatic traffic counter is that the information can be accumulated over a twenty-four hour period. More information is available from the manual method, since not only can vehicular and pedestrian traffic be recorded, but also the types of turning movements involved, e.g., left and right turns. This information is maintained on a street and intersection basis.

This traffic flow information enhances the road needs study with volume of traffic data. It is used to identify potential problem locations as well as the effect of potential traffic sign or light changes. Traffic patterns are established for monthly, daily or longer term periods. This information is useful for City traffic planning as well as for road design. In time, the information could be used for transportation studies and for more complex traffic analysis used in computer modelling techniques.

3. Street Lighting

This Section monitors street lighting contracts with Ontario Hydro. Cambridge, in conjunction with North Dumfries, has elected to use Ontario Hydro to manage their street lighting system. In present procedure, Hydro maintains all of the resources and charges the Municipality for the services rendered on a monthly basis. New equipment that is installed is depreciated over a ten-year period. Essentially, the City now owns the system. The Municipality authorizes any additions and deletions.

4. Issuance of Permits

This Section also issues special events and heavy load permits (e.g., for road construction). This is used to co-ordinate parade and construction traffic when needed.

5. Pedestrian Analysis

Some information is maintained on the pedestrian traffic throughout the City. Pedestrian flow is analysed and used in the same manner as vehicular flow. This is useful in planning traffic sign locations, traffic by-laws, and so forth, within the City core.

DATA SOURCES

The primary sources of information that are used in performing the Section's responsibilities are as follows:

a. **Regional Traffic Files** - This information is presented to the Municipality in a report format. Esssentially, collision information is summarized on a street and intersection basis. It is possible to ask for specific fields, such as detailed descriptions of collisions which are maintained in the file system. The collisions are indexed by a collision number as well as date of collision.

b. **Street Maps** - There is limited use of maps within this Section except for the Master Schematic street maps at

a scale of 1" = 1 600' provided by the Engineering Division.

OBSERVATIONS

The Traffic Section makes extensive use of positionally related information such as traffic volumes by street and intersection, traffic sign locations, etc., specifically, for traffic flow and collision analysis. Most of the analysis is now done manually. It would be desirable in the future to have access to computer models to assist in this capacity.

Unfortunately, much of the analysis is done after the fact. For example, it would be meaningful to have access to more information which would allow for predictive analysis, and hence eliminate potential problems before they occur.

There is incomplete information on the street lighting inventory with Ontario Hydro. At present, Ontario Hydro does not have an automated system for a street light inventory and is relying on a manual system. It is anticipated that it will be three to five years before Hydro is on-line with this inventory. It is difficult to monitor this street lighting contract when there is incomplete information about the lighting system inventory as well as future plans for the system.

FUTURE NEEDS AND WANTS

The Section felt that it would be desirable to have information about traffic volumes, flows, intersection locations, collision data and so forth displayed on an interactive screen or in a hard copy format on demand. This would assist in more effective analysis of data. For example, these capabilities would be of benefit in analysing flow and collision data, and in planning of road networks from traffic and volume data.

In regard to collision analysis, the Section has found it desirable to have the collision information referenced by collision number and data. In addition, location by street and/or intersection would be desirable.

A need to have better control of the information available for the street and lighting contract was identified by the Traffic Section. For example, the inventory of street hardware as well as associated information could be maintained by the Municipality for more effective monitoring of the work done by Ontario Hydro.

More complete information about traffic within the Municipality would greatly assist in scheduling and rerouting of traffic, specifically, for construction and special events. The availability of further information about traffic patterns, e.g., traffic flows, volumes, and turns would be useful for busines development activities within the Municipality.

The Section indicated a need to have available computer-assisted

techniques for analysing much of the information associated with traffic in the Municipality. This could be achieved by acquiring various analysis packages for use within this mandate area which would require a structured data base for managing the various traffic information within the Municipality.

G.I.S. POTENTIAL

There are many potential uses for a G.I.S. system in the Traffic Section. An automated system would be of benefit to this Section to be able to maintain traffic volume and flow data in order that a variety of analyses (e.g., traffic trends analyses) could be performed. On-line query would also benefit this Section in order to obtain information on road networks such as road type, length, width, etc. A graphic display capability would be an aid in superimposing point data (e.g., collision data on to the street map base). A variety of analyses (e.g., traffic trends) could be performed. A variety of analysis programming would be used for planning of traffic flows, hence assist in alleviating congestion.

DATA SOURCE INFORMATION SHEET

TITLE: TRAFFIC SIGN INVENTORY

SOURCE AGENCY: Traffic Section
PERSON: Roy Simonoski
TITLE: Coordination of Traffic
ADDRESS: 73 Water St. North
Box 669
Cambridge, Ontario N1R 5W8

PHONE: (519) 623-1340

DESCRIPTION:
Inventory on a map, of all traffic signs in Cambridge

FORMAT:

	M	A	MEDIA
MAP	X		paper
TABULAR			
IMAGE			
TEXT			
LIBRARY			

NOTE: super imposed on schematic master.
SCALE: 1" = 200'

ACCURACY/RESOLUTION: limited but traffic data manually superimposed on schematic master.

SIZE/VOLUME: 1 map.

GROWTH RATE: 0

DATA ITEMS:

- street name
- sign location
- type of sign

RETRIEVAL KEY(S): N/A

GEOCODE: none

DATE OF CREATION: 1973

FREQUENCY OF UPDATE: twice a month.

COVERAGE/COMPLETENESS: Municipality.

SOURCE OF INFORMATION:
field crew survey and Public Works Division.

USERS OF INFORMATION:
Public Works Division
Traffic Section

VOLUME/FREQUENCY OF USE: unknown

ACCESS METHOD FOR USER:
- view map in traffic section
- phone

AVAILABILITY: open

CHARGES: none

HARDWARE AND LOCATION:
73 Water St. North, Cambridge, Ontario

SOFTWARE:

NOTES (PROBLEMS, DEPENDENCIES, ETC.)

GEOGRAPHIC DATA MANAGEMENT PROCEDURES

TITLE:

CITY OF CAMBRIDGE

Traffic Analysis

LEGEND:
- ○ MANUAL PROCESS
- ● NOW DONE MANUALLY WANT TO AUTOMATE
- ◉ AUTOMATED PROCESS
- □ DON'T DO NOW BUT WANT TO

| AGENCY FUNCTIONS | TABULAR DATA | CARTOGRAPHIC DATA | | |

7. Identification of Information Needs and Uses

The individual interview reports for municipalities were then reviewed and integrated into various forms of summary analysis. These types of analysis included: quantification estimates of potential use of geographic data management procedures; a synthesis of observed generic municipal tasks; and a summary analysis of the software procedures which would typically be employed in carrying out the observed generic tasks.

It should be noted that these types of analysis were not prepared for the provincial reports, because of differences in objectives and aims of the two sets of reports.

a. Quantification Estimates of the Potential Use of Geographic Data Management Procedures

Both to understand how tasks are carried out in municipalities and how tasks might be carried out if certain automated tools were availabe, quantification estimates were obtained regarding the use of various geographic data management procedures.

Using a chart similar to Figure 4, interview teams were asked to document the number of times on an annual basis that a given geographic data management procedure is currently, and may be potentially, carried out for each agency task. The estimates were intended to reflect ongoing municipal activities. The term 'existing' to represent use of current manual/automated technicques, 'potential' to represent the estimated use of a procedure if an automated G.I.S. facility were available.

The summary statistics offered range estimates of existing and potential use of geographic data management procedures. The conclusions drawn from these basic quantification estimates provided greater insight regarding municipal uses of geographic data management procedures.

b. Observed Generic Municipal Tasks

The interview reports identified an array of specific municipal tasks which involve land-related information. By synthesizing these identified tasks into a single, non-duplicative list, a set of observed generic municipal tasks was identified and defined. The following tasks were included in this list:

Acquire/Dispose Property
Process/Issue Permits
Perform Inspections
Issue Work Orders
Issue Licences
Conduct Street Naming
Manage Mailing List
Review/Approve Site Plans
Review/Approve Subdivisions

Perform Street Addressing
Perform Event Recording
Dispatch Vehicles
Perform Vehicle Routing
Conduct Traffic Analysis
Allocate Human Resources
Site Facilities
Conduct Area Districting
Manage/Survey Facilities
Manage Inventories
Manage Resources
Administer Zoning By-laws
Prepare Official/Secondary Plans
Conduct Engineering Design
Conduct Drafting
Maintain Topographic Data Base
Manage Drawings
Disseminate Public Information
Conduct Development Tracking
Respond to Public Enquiries
Conduct Title Searches
Bill/Collect Taxes and Fees
Manage Data Bases/Systems
Document Management and Retrieval

The correlation between the individual municipal tasks identified during interviews and the generic list of tasks was illustrated in a set of matrices. An example of this correlation matrix is contained in Figure 6.

c. Summary Analysis of Software Procedures Typically Employed in Municipal Tasks

Using the set of observed generic municipal tasks, a matrix was also produced portraying the generic tasks which currently or potentially could utilize various geographic data management software procedures. This matrix (Figure 7) simplifies and synthesizes the information contained in individual interview reports.

This matrix is useful in that it offers some general insight on the range of procedures available and their generally perceived applicability to municipal tasks. It reflected the opinions of the TWIG teams and the advisory group (Jim Linders and myself) in conjunction with the municipal representatives who were interviewed.

8. Evaluation of Existing Information Resources

The data source sheets completed for each data item identified in the interviews represented one of several steps taken to evaluate existing information resources. Data summaries, data type and source analyses, and syntheses of data requirements were also prepared. Again, it must be

Table 6.1 OBSERVED GENERIC MUNICIPAL TASKS

CITY OF WOODSTOCK Specific Observed Municipal Tasks	Acquire/Dispose Property	Process/Issue Permits	Perform Inspections	Issue Work Orders	Issue Licences	Conduct Street Naming	Manage Mailing Lists	Review/Approve Site Plans	Review/Approve Subdivs.	Perform Street Addressing	Perform Event Recording	Dispatch Vehicles	Perform Vehicle Routing	Conduct Traffic Analysis	Allocate Human Resources	Site Facilities	Conduct Area Districting	Manage/Survey Facilities	Manage Inventories	Manage Resources	Administer Zoning Bylaws	Prepare Ofcl/Zoning Plans	Conduct Engg. Design	Conduct Drafting	Maintain Topo. Data Base	Manage Drawings	Disseminate Public Info.	Development Tracking	Public Enquiry Response	Conduct Title Searches	Tax/Fee Billing/Collection	Data Base/System Mngmt.
1. Design & Layout of Roads/Sewers																							•									
2. Piling/Maintaining Maps & Plans																								•	•							
3. Maintenance of Control Networks																	•															
4. Response to Public Enquiries																											•					
5. Issuance & Maintenance of Building Permits		•																														
6. Building Inspection & Bylaw Enforcement			•	•																	•											
7. Administering Hose Inspection & Improvement Program			•	•																						•						
8. Maintaining Roads, Sidewalks and Sewers																		•														
9. Operating Garbage & Road Cleaning Program													•					•														
10. Assigning Addresses										•																						
11. Tax Billing & Collection																															•	

Figure 6

Table 6.1 OBSERVED GENERIC MUNICIPAL TASKS

CITY OF WOODSTOCK (continued)	Acquire/Dispose Property	Process/Issue Permits	Perform Inspections	Issue Work Orders	Issue Licenses	Conduct Street Rental	Manage Mailing Lists	Review/Approve Site Plans	Review/Approve Subdivs.	Perform Street Addressing	Perform Event Recording	Dispatch Vehicles	Perform Vehicle Routing	Conduct Traffic Analysis	Allocate Human Resources	Site Facilities	Conduct Area Electricity	Manage/Survey Facilities	Manage Inventories	Manage Resources	Administer Zoning Bylaws	Prepare Offcl/Boundry Plans	Conduct Engg. Design	Conduct Drafting	Maintain Topo. Data Base	Manage Brewings	Disseminate Public Info.	Development Tracking	Public Enquiry Response	Conduct Title Searches	Tax/Fee Billing/Collection	Data Base/System Mgmt.
Specific Observed Municipal Tasks																																
12. Selection of Polling Districts																	•															
13. Identifying Residents Affected by Local Improvements							•																								•	
14. Planning/Selection of Recreation Sites								•																								
15. Conducting Tree Inventory																		•	•													
16. Managing Transit Services and Route Selection													•																			
17. Fire Preplanning & Dispatching												•																				
18. Fire Fighting														•																		
19. Conducting Fire Prevention Inspections			•	•																												
20. Design, Installation & Maintenance of Water/Hydro Facilities																•		•					•									
21. Install/Maintain Telephone Service																			•													
22. Design/Install/Mntn. Gas Facils.																•	•															

Figure 6 (continued)

Table 6.1 OBSERVED GENERIC MUNICIPAL TASKS

COUNTY OF OXFORD Specific Observed Municipal Tasks	Acquire/Dispose Property	Process/Issue Permits	Perform Inspections	Issue Work Orders	Issue Licences	Conduct Street Naming	Manage Building Lists	Review/Approve Site Plans	Review/Approve Subdiv.	Perform Street Addressing	Perform Event Recording	Dispatch Vehicles	Perform Vehicle Rental	Conduct Traffic Analysis	Allocate Human Resources	Site Facilities	Conduct Area Electrical	Manage/Survey Facilities	Manage Inventories	Manage Resources	Administrator Zoning Bylaws	Prepare Offcl/Sendry Plans	Conduct Engr. Design	Conduct Drafting	Maintain Topo. Data Base	Manage Drawings	Disseminate Public Info.	Development Tracking	Public Enquiry Response	Conduct Title Searches	Tax/Fee Billing/Collection	Data Base/System Mgmt.
21. Preparing Official Plans and Zoning Bylaws																					•	•										
24. Preparing Zoning Bylaw Amendments																				•												
25. Preparing Development Reports (including parcel maps)																						•										
26. Approval of Subdivision Plans									•																							
22. Processing of Severances & Variances																					•											
28. Design and Construction of County Roads																							•									
29. Drainage Management																			•													
30 Providing Ambulance Services and Recordkeeping												•	•																			

Figure 6 (continued)

Table 6.1 OBSERVED GENERIC MUNICIPAL TASKS

CITY OF CAMBRIDGE Specific Observed Municipal Tasks	Acquire/Dispose Property	Process/Issue Permits	Perform Inspections	Issue Work Orders	Issue Licenses	Conduct Street Rental	Manage Rolling Stock	Review/Approve Site Plans	Review/Approve Budgets.	Perform Street Addressing	Perform Event Recording	Dispatch Vehicles	Perform Vehicle Routing	Conduct Traffic Analysis	Allocate Human Resources	Site Feasibilities	Conduct Area Electricity	Manage/Survey Facilities	Manage Inventories	Manage Resources	Administer Zoning Bylaws	Prepare Ofcl/Zoning Plans	Conduct Engg. Design	Conduct Drafting	Maintain Topo. Data Base	Manage Drawings	Disseminate Public Info.	Development Tracking	Public Enquiry Response	Conduct Title Searches	Tax/Fee Billing/Collection	Data Base/System Mgmt.
31. Bus Stop & Route Planning													•																			
32. Answering Public Queries																													•			
33. Scheduling Recreational Facilities																		•														
34. Maintaining Personnel & Recreation Facilities															•			•														
35. Planning & Development of Recreational Facilities																•			•													
36. Issuing Business Licenses					•																											
37. Administering Boundaries																		•														
38. Tax Registration																						•									•	
39. Developing Official Plan																					•											
40. Implementing Official Plan				•																	•											
41. Building Permit Approval		•																														
42. Answering Public Enquiries																													•			
43. Permit Application & Issuance		•																														
44. Assigning House Numbers											•																					

Figure 6 (continued)

Table 6.1 OBSERVED GENERIC MUNICIPAL TASKS

CITY OF CAMBRIDGE (continued) Specific Observed Municipal Tasks	Acquire/Dispose Property	Process/Issue Permits	Perform Inspections	Issue Work Orders	Issue Licenses	Conduct Street Manint.	Manage Building Lists	Review/Approve Site Plans	Review/Approve Subdivs.	Perform Street Addressing	Perform Event Recording	Dispatch Vehicles	Perform Vehicle Routing	Conduct Traffic Analysis	Allocate Human Resources	Site Facilities	Conduct Area Electricting	Manage/Survey Facilities	Manage Inventories	Manage Resources	Administrator Zoning Bylaws	Prepare Ofcl/Bondry Plans	Conduct Engr. Design	Conduct Drafting	Maintain Topo. Data Base	Manage Drawings	Disseminate Public Info.	Development Tracking	Public Enquiry Response	Conduct Title Searches	Tax/Fee Billing/Collection	Data Base/System Mgmt.
45. Entering Building Standards			•																													
46. Response to Enforcement Queries			•																													
47. Drafting Engineering Designs																							•									
48. Drafting Maps																								•								
49. Monitoring Project Development																											•					
50. Managing Capital Projects																	•															
51. Maintaining Easement Inventory																		•														
52. Maintaining Control Network																	•															
53. Administering Asphalt/Concrete Wk.																	•															
54. Analysing Collisions & Traffic														•																		
55. Maintaining Parking Inventory																		•														
56. Maintaining Roads, Sewers and Waterlines																	•															
57. Administering Lanes and Road Closures																				•												
58. Ensuring Safety from Fire				•																												

Figure 6 (continued)

Table 6.1 OBSERVED GENERIC MUNICIPAL TASKS

CITY OF CAMBRIDGE (continued) Specific Observed Municipal Tasks	Acquire/Dispose Property	Process/Issue Permits	Perform Inspections	Issue Work Orders	Issue Licenses	Conduct Street Naming	Manage Building Lists	Review/Approve Site Plans	Review/Approve Subdivs.	Perform Street Addressing	Perform Event Recording	Dispatch Vehicles	Perform Vehicle Routing	Conduct Traffic Analysis	Allocate Human Resources	Site Facilities	Conduct Area Electricing	Manage/Survey Facilities	Manage Inventories	Manage Resources	Administer Zoning Bylaws	Prepare Ofcl/Zoning Plans	Conduct Engr. Design	Conduct Drafting	Maintain Topo. Data Base	Manage Drawings	Disseminate Public Info.	Development Tracking	Public Inquiry Response	Conduct Title Searches	Tax/Fee Billing/Collection	Data Base/System Mgmt.
59. Industrial Park Development	•																					•									
60. Liaise with Business Community																											•				
61. Planning and Developing Recreational Facilities																						•					•				

Figure 6 (continued)

Table 6.1 OBSERVED GENERIC MUNICIPAL TASKS

CITY OF MISSISSAUGA Specific Observed Municipal Tasks	Acquire/Dispose Property	Process/Issue Permits	Perform Inspections	Issue Work Orders	Issue Licenses	Conduct Street Naming	Manage Mailing Lists	Review/Approve Site Plans	Review/Approve Subdivs.	Perform Street Addressing	Perform Event Recording	Dispatch Vehicles	Perform Vehicle Routing	Conduct Traffic Analysis	Allocate Human Resources	Site Facilities	Conduct Area Districting	Manage/Survey Facilities	Manage Inventories	Manage Resources	Administer Zoning Bylaws	Prepare Ofcl/Sendry Plans	Conduct Engg. Design	Conduct Drafting	Maintain 'spc. Data Base	Manage Drawings	Disseminate Public Info.	Development Tracking	Public Enquiry Response	Conduct Title Searches	Tax/Fee Billing/Collection	Data Base/System Mgmt.
62. Street Addressing										•																					
63. Coordinating P.U.C.C. Actions																•		•													
64. Design of Capital Works																						•									
65. Provision of Drafting Services																							•		•						
66. Conducting Surveys and Preparing Relevant Bylaws																		•													
67. Administering Maintenance & Works Projects																•		•													
68. Subdivision Development Control									•																						
69. Subdivision Construction					•																	•									
70. Management of Storm Drainage Facilities																		•													
71. Construction & Maintenance of Traffic Facilities																		•													
72. Street Lighting Design																•															
73. Processing Development Applics.		•																													

Figure 6 (continued)

Table 6.1 OBSERVED GENERIC MUNICIPAL TASKS

CITY OF MISSISSAUGA (continued) Specific Observed Municipal Tasks	Acquire/Dispose Property	Process/Issue Permits	Perform Inspections	Issue Work Orders	Issue Licences	Conduct Street Naming	Manage Mailing Lists	Review/Approve Site Plans	Review/Approve Subdivs.	Perform Street Addressing	Perform Event Recording	Dispatch Vehicles	Perform Vehicle Routing	Conduct Traffic Analysis	Allocate Human Resources	Site Facilities	Conduct Area Districting	Manage/Survey Facilities	Manage Inventories	Manage Resources	Administer Zoning Bylaws	Prepare Ofcl/Sendry Plans	Conduct Engg. Design	Conduct Drafting	Maintain Topo. Data Base	Manage Drawings	Disseminate Public Info.	Development Tracking	Public Enquiry Response	Conduct Title Searches	Tax/Fee Billing/Collection	Data Base/System Mgmt.
74. Responding to Development Queries																						•									
75. Preparing Official & Secondary Plans																											•				
76. Monitoring Development																												•			
77. Responding to other Planners																													•		
78. Preparing Planning Studies																						•									
79. Site Plan Processing								•																							
80. Urban Design Policy & Architectural Coordination																						•									
81. Office Services Assistance																			•												
82. Generating Mailing Lists							•																								
83. Planning Support Services																						•									
84. Providing Planning Consulting																						•									
85. Open Space Planning																						•									
86. Park Master Planning																						•									
87. Landscape Design Approval								•																							

Figure 6 (continued)

Table 6.1 OBSERVED GENERIC MUNICIPAL TASKS

CITY OF MISSISSAUGA (continued) Specific Observed Municipal Tasks	Acquire/Dispose Property	Process/Issue Permits	Perform Inspections	Issue Work Orders	Issue Licences	Conduct Street Naming	Manage Mailing Lists	Review/Approve Site Plans	Review/Approve Subdivs.	Perform Street Addressing	Perform Event Recording	Dispatch Vehicles	Perform Vehicle Routing	Conduct Traffic Analysis	Allocate Human Resources	Site Facilities	Conduct Area Districting	Manage/Survey Facilities	Manage Inventories	Manage Resources	Administer Zoning Bylaws	Prepare Ofel/Sendry Plans	Conduct Engg. Design	Conduct Drafting	Maintain Topo. Data Base	Manage Drawings	Disseminate Public Info.	Development Tracking	Public Enquiry Response	Conduct Title Searches	Tax/Use Billing/Collection	Data Base/System Mngmt.
88. Parks Development																•															
89. Forest Resource Management																				•											
90. Historical Preservation																			•												
91. Tax Billing & Collection																														•	
92. Developing Information Systems																															•
93. Operating Computer Facilities																															•
94. Legal Searches & Documentation																												•			
95. Suppressing Fires												•			•																
96. Preparing Fire Response Reports											•																				
97. Conducting Fire Inspections			•	•																											
98. Providing Realty Services	•																												•		
99. Establishing Property Information System																			•												
100. Coordinating Elections																	•														
101. Coordinating Development Activity																											•				

Figure 6 (continued)

Table 6.1 OBSERVED GENERIC MUNICIPAL TASKS

CITY OF MISSISSAUGA (continued) Specific Observed Municipal Tasks	Acquire/Dispose Property	Process/Issue Permits	Perform Inspections	Issue Work Orders	Issue Licences	Conduct Street Naming	Manage Mailing Lists	Review/Approve Site Plans	Review/Approve Subdivs.	Perform Street Addressing	Perform Event Recording	Dispatch Vehicles	Perform Vehicle Routing	Conduct Traffic Analysis	Allocate Human Resources	Site Facilities	Conduct Area Dietricting	Manage/Survey Facilities	Manage Inventories	Manage Resources	Administrator Zoning Bylaws	Prepare Ofcl/Secndry Plans	Conduct Engg. Design	Conduct Drafting	Maintain Topo. Data Base	Manage Drawings	Disseminate Public Info.	Development Tracking	Public Enquiry Response	Conduct Title Searches	Tax/Fee Billing/Collection	Data Base/System Mgmt.
102. Compiling Public Information																											•					
103. Preparing Public Relations Materials																											•					
104. Conducting Rider Surveys														•																		
105. Maintaining Bus Stop Inventory																	•	•														
106. Conducting Route Planning													•																			
107. Process and Issue Permits			•																		•											
108. Perform Inspections				•	•																											
109. Licence Trades and Establishments						•																										
110. Zoning Actions				•																												
111. Preparing and Maintaining Business Directory																											•					
112. Preparing Statistical and Information Profiles																												•				
113. Business Development Liaison and Departmental Coordination																													•			

Figure 6 (continued)

Table 6.1 OBSERVED GENERIC MUNICIPAL TASKS

CITY OF MISSISSAUGA (continued) Specific Observed Municipal Tasks	Acquire/Dispose Property	Process/Issue Permits	Perform Inspections	Issue Work Orders	Issue Licences	Conduct Street Rental	Manage Building Lists	Review/Approve Site Plans	Review/Approve Subdivs.	Perform Street Addressing	Perform Event Recording	Dispatch Vehicles	Perform Vehicle Routing	Conduct Traffic Analysis	Allocate Human Resources	Site Facilities	Conduct Area Distributing	Manage/Survey Facilities	Manage Inventories	Manage Resources	Administrator Zoning Bylaws	Prepare Offcl/Zoning Plans	Conduct Engr. Design	Conduct Drafting	Maintain Topo. Data Base	Manage Drawings	Disseminate Public Info.	Development Tracking	Public Enquiry Response	Conduct Title Searches	Tax/Fee Billing/Collection	Data Base/System Mgmt.
114. Gathering and Marketing Air Photo Mosaics																			•													
115. Customer Accounting																•																
116. Plan Inspection and Design																							•	•	•							
117. Map and Drawing Production																										•	•	•	•	•		

Figure 6 (continued)

Table 6.3

GEOGRAPHIC DATA MANAGEMENT PROCEDURES

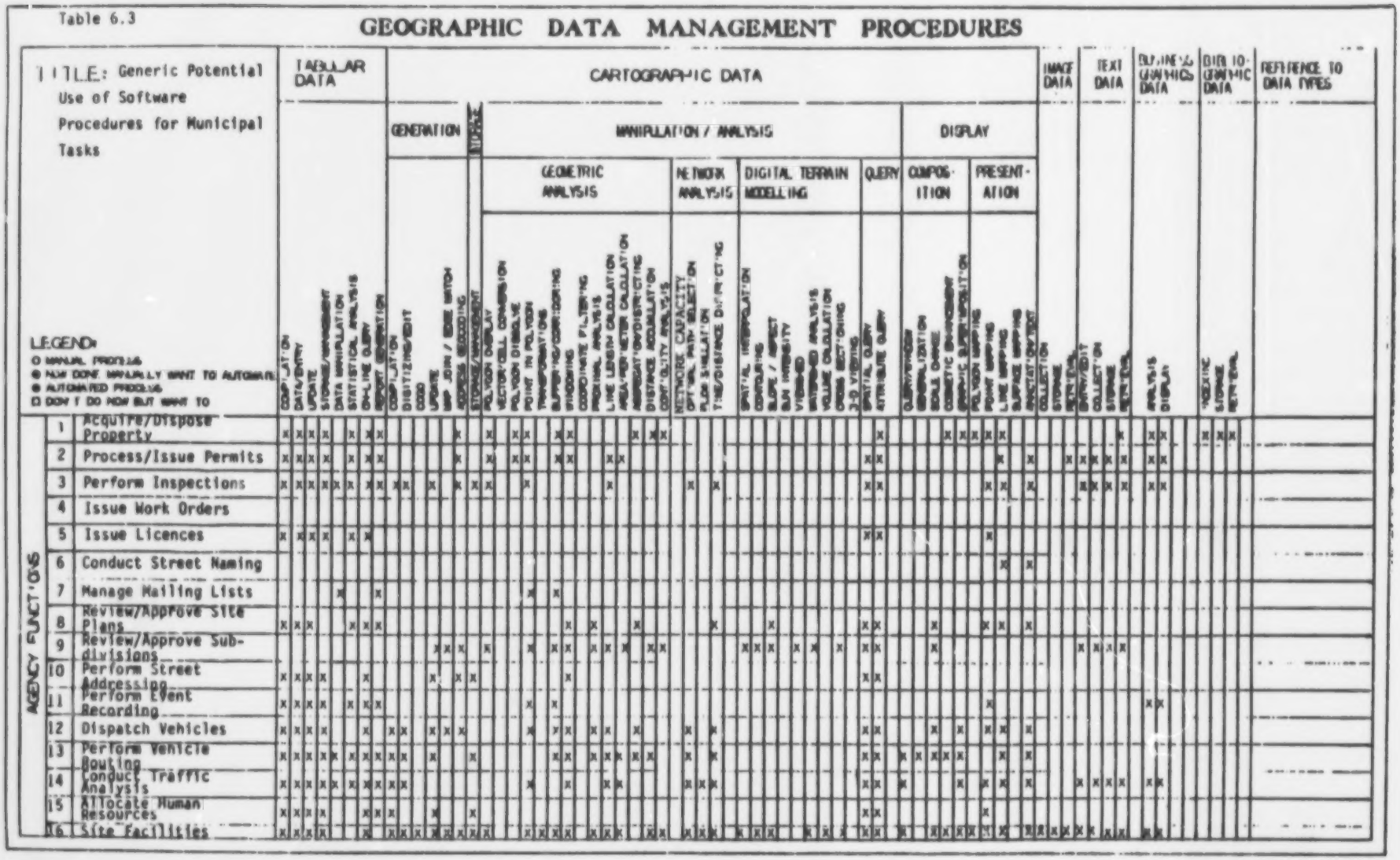

Figure 7

Table 6.3

GEOGRAPHIC DATA MANAGEMENT PROCEDURES

TITLE:

LEGEND:
- ○ MANUAL PROCESS
- ● HOW DOES MANUALLY WANT TO AUTOMATE
- ◉ AUTOMATED PROCESS
- □ DON'T DO HOW BUT WANT TO

AGENCY FUNCTIONS	TABULAR DATA	CARTOGRAPHIC DATA					IMAGE DATA	TEXT DATA	BUSINESS GRAPHICS DATA	BIBLIOGRAPHIC DATA	REFERENCE TO DATA TYPES
		GENERATION	MANIPULATION / ANALYSIS				DISPLAY				
			GEOMETRIC ANALYSIS	NETWORK ANALYSIS	DIGITAL TERRAIN MODELLING	QUERY	COMPOSITION	PRESENTATION			
17 Conduct Area Districting	X	X	X	X		X		X			
18 Manage/Survey Facilities	X	X	X	X		X	X	X			
19 Manage Inventories	X	X	X	X		X	X	X	X	X	
20 Manage Resources	X	X	X	X		X	X	X	X	X	
21 Administer Zoning Bylaws	X	X	X	X	X	X	X	X	X	X	
22 Prepare Official/ Secondary Plans	X	X	X	X	X	X	X	X	X	X	
23 Conduct Engineering Design	X	X	X	X	X	X	X	X	X	X	
24 Conduct Drafting	X	X	X	X	X	X	X	X	X	X	
25 Maintain Topographic Data Base	X	X	X	X	X	X	X	X	X	X	
26 Manage Drawings	X	X	X	X	X	X	X	X	X	X	
27 Disseminate Public Information	X	X	X	X	X	X	X	X	X	X	X
28 Conduct Development Tracking	X	X	X	X	X	X	X	X	X	X	
29 Respond to Public Enquiries	X	X	X	X	X	X	X	X	X	X	
30 Conduct Title Searches	X	X	X	X	X	X	X	X	X	X	
31 Bill/Collect Taxes and Fees	X	X	X	X	X	X	X	X	X	X	
32 Manage Data Bases/ Systems	X	X	X	X	X	X	X	X	X	X	

Figure 7 (continued)

noted that this level of detail was not undertaken in the provincial study for which different objectives were identified and less indepth analaysis was appropriate.

a. Data Summary Charts

Once data source sheets were completed for each organization a data summary chart was prepared for all data sources within each municipality. These charts were designed to provide easy reference for data analysis and conceptual and functional modelling activities.

Each data summary chart recorded the following information: the data item, its format, sizes, frequence of update, geocodes, number of staff to maintain, volume and frequency of use, and existing users of the data. A copy of the data summary chart form is contained in Figure 8.

b. Summary of Data Types and Sources

Another form of data analysis was conducted to identify the source agencies of particular data, as well as their base sources. Charts were prepared to record the findings of this analysis for both map and tabular data types, as illustrated in Figures 9 and 10, respectively.

The source and base source agencies of specific data items are important to understand for two reasons. First, it is useful to identify generally perceived trends regarding the agencies which maintain and distribute data, and the agencies which are typically depended upon to provide base source materials. For example, we found that municipal Treasury or Revenue agencies store, maintain and distribute parcel assessment data, but depend upon the provincial Ministry of Revenue as the base source for this data. Secondly, these data dependencies and interrelationships are meaningful and necessary to understand for the purpose of creating conceptual and functional models for broad municipal application, and for data base/system design.

c. Potential Uses and Data Requirements

The analysis of the matrices completed for each data item in regard to data types and sources produced additional information. We found that there are nine major categories of land-related data which are used and/or maintained by municipal and provincial agencies. These are as follows:

- Base Maps and Control Survey Data - Data pertaining to horizontal and/or vertical control surveys, and base maps generated using these data.

CHAPTER REF.	DATA ITEM	FORMAT		SIZES	FREQUENCY OF UPDATE	GEOCODE								NUMBER OF STAFF TO MAINTAIN	VOLUME/ FREQUENCY OF USE	WHO USES
		ELEC.	MAN.			TAX PARCEL	ADDRESS	X Y COORD.	GBL	POLYGON	MAP WINDOW					

Figure 8

MAP DATA TYPES AND SOURCES

DATA TYPES	SOURCE AGENCY	BASE SOURCE	MEDIA		SIZE OF DATA BASE	MAP SCALE
			M	A		

Figure 9

TABULAR DATA TYPES AND SOURCES

DATA TYPES	SOURCE AGENCY	BASE SOURCE	MEDIA		SIZE OF DATA BASE	MAP SCALE
			M	A		

Figure 10

- **Parcel Maps** - Maps containing data about the location, size and boundary of parcels, portrayed in graphic format. A range of other data is also displayed on parcel maps, including, but not limited to, utility data, building permit data, planning/zoning/land use data, etc.

- **Network Maps** - Maps showing street and utility networks, and used to display these data, as well as public service routes and facilities inventories.

- **Statistical Polygons** - Data on statistical, demographic and administrative area boundaries. Used generally in analysing and displaying census, zoning and land use data, as well as summarizing emergency service response statistics, co-ordinating elections, etc.

- **Environmental/Land Use Maps** - Includes point, line and polygon natural physical features as well as topographical data. Used in thematic mapping for planning and development activities, infrastructure design analysis, and resource management.

- **Network Tabular Data** - Encompasses tabular data on streets, utilities and other network features.

- **Parcel Tabular Data** - Includes legal, land cadastre, and other attribute data associated with land parcels.

- **Areal Unit Tabular Data** - Includes all tabular data associated with statistical polygons, pertaining to statistical, demographic, census, administrative and other area boundaries.

- **Engineering Drawings** - Includes both engineering overlays and plan/profile drawings used in engineering design, construction and management.

Using these data categories or data entities (as they are also called), we sought to clarify the relationships which exist between these data and the municipal tasks or uses to which they are applied. Figure 11 illustrates some findings from the municipal study regarding prevalent observed municipal activities which use land-related data, and the data entities used in carrying them out.

Again, this level of detailed analysis was not documented for the provincial level, due to divergent study objectives, which were previously identified.

Table 6.2

POTENTIAL USES AND DATA REQUIREMENTS

OXFORD/WOODSTOCK		DATA REQUIREMENTS								
		BASE MAPS & CONTROL SURVEY DATA	PARCEL MAPS	NETWORK MAPS	STATISTICAL POLYGONS	ENVIRONMENTAL LAND USE MAPS	NETWORK TABULAR DATA	PARCEL TABULAR DATA	AREAL UNIT DATA	ENGINEERING DRAWINGS
POTENTIAL USES	Maintaining & Displaying Compiled Utility Data		X	X			X	X		X
	Drafting Eng. Plans -Cross Sections -Plan/Profiles	X								X
	Designing Roads & Utility Services and Layout	X	X	X	X	X	X		X	X
	Processing, Selecting and Storing Hdth. Format Data		X					X		
	Optimizing Routes for Transit, Garbage, Fire, Ambulance, etc.			X	X		X		X	
	Generating Mailing Labels		X					X		
	Defining Election Polling Areas		X						X	
	Analyzing Field Drainage for Tile Beds			X		X	X		X	
	Creating and Maintaining Parcel Base Maps	X	X					X		
	Retrieving Parcel Cadastral Info. from Registry Office		X					X		
	Collect, Maintain, Display Zoning, Land Use Data		X			X		X		
	Store and Display Census Data		X		X				X	

Figure 11

Table 6.2

POTENTIAL USES AND DATA REQUIREMENTS

POTENTIAL USES	DATA REQUIREMENTS								
	BASE MAPS & CONTROL SURVEY DATA	PARCEL MAPS	NETWORK MAPS	STATISTICAL POLYGONS	ENVIRONMENTAL LAND USE MAPS	NETWORK TABULAR DATA	PARCEL TABULAR DATA	AREAL UNIT DATA	ENGINEERING DRAWINGS
Manipulate & Analyze Zoning Land Use & Census Data		X		X	X		X	X	
Analysis of Fire, Health & Building Inspection Records		X		X			X	X	
Scheduling Works and Parks Maintenance Programs		X	X				X		
Maintaining Records of Park Inventory							X		
Maintaining Tree Inventories & Displaying Locations		X					X		
Identifying Fire & Ambulance Request Location from Ge...		X					X		
Creating Fire Response Site Plans		X							X
Scheduling Health and Fire Inspections							X		
Plotting Communicable Diseases on Maps		X		X	X			X	
Analysis of Ambulance Requests for Road Design			X			X		X	

Figure 11 (continued)

Table 6.2

POTENTIAL USES AND DATA REQUIREMENTS

CAMBRIDGE	DATA REQUIREMENTS								
POTENTIAL USES	BASE MAPS & CONTROL SURVEY DATA	PARCEL MAPS	NETWORK MAPS	STATISTICAL POLYGONS	ENVIRONMENTAL LAND USE MAPS	NETWORK TABULAR DATA	PARCEL TABULAR DATA	AREAL UNIT DATA	ENGINEERING DRAWINGS
Preparation of Mailing Lists		x					x		
Applications/ Permits		x			x		x		
Spatial Query	x	x	x	x	x	x	x	x	
Attribute Query	x	x	x	x	x	x	x	x	
Inventory Maintenance	x	x	x		x	x	x		x
Network Analysis	x	x	x	x		x	x	x	
Modelling	x	x	x	x	x	x	x	x	
Specialized Map Graphics	x								
Thematic Mapping		x	x		x		x	x	
Administering Development	x	x	x		x	x	x		x

Figure 11 (continued)

Table 6.2

POTENTIAL USES AND DATA REQUIREMENTS

MISSISSAUGA		DATA REQUIREMENTS								
		BASE MAPS & CONTROL SURVEY DATA	PARCEL MAPS	NETWORK MAPS	STATISTICAL POLYGONS	ENVIRONMENTAL LAND USE MAPS	NETWORK TABULAR DATA	PARCEL TABULAR DATA	AREAL UNIT DATA	ENGINEERING DRAWINGS
POTENTIAL USES	Maintain Tax File							x	x	
	Management of City Owned Trees		x	x		x	x	x		
	Preserve Historical Sites		x			x		x	x	
	Design Analysis for Development				x	x			x	x
	Maintain Parcel Related Information Files		x		x	x		x	x	
	Design Response Routing			x	x	x	x		x	
	Purchase or Sell City Property		x		x	x		x	x	
	Perform Assessment Review		x		x	x		x	x	
	Co-ordinate Elections		x	x	x			x	x	
	Inventory City Facilities			x			x			

Figure 11 (continued)

Table 6.2

POTENTIAL USES AND DATA REQUIREMENTS

POTENTIAL USES	DATA REQUIREMENTS								
	BASE MAPS & CONTROL SURVEY DATA	PARCEL MAPS	NETWORK MAPS	STATISTICAL POLYGONS	ENVIRONMENTAL LAND USE MAPS	NETWORK TABULAR DATA	PARCEL TABULAR DATA	AREAL UNIT DATA	ENGINEERING DRAWINGS
Provide Street Addresses		x	x						
Co-ordinate Public Utility Activities			x						x
Administer Capital Works Projects	x	x	x		x				x
Maintain City Streets and Property	x	x	x		x		x		x
Provide Graphic & Information Support (Drafting)	x	x	x		x		x		x
Control of Sub-division Development	x	x	x		x		x		x
Maintenance of Traffic and Storm Drainage Networks			x		x	x			x
Provide Legal Support Services	x	x	x				x		
Generate Mailing Lists		x					x	x	
Respond to Public Enquiries		x	x	x	x	x	x	x	
Prepare Official & Secondary Plans		x	x	x	x	x	x	x	
Prepare Planning Reports		x	x	x	x	x	x	x	

Figure 11 (continued)

9. Syntheses of Conclusions for Conceptual and Functional Model Development

In this last task, summary analyses were prepared with findings and conclusions from the provincial and municipal user needs studies. Essentially, these summaries were written based upon the finding of various analyses which were previously described, as well as observations of the various interviewers during the course of the project.

These conclusions and findings would be applied subsequently in the preparation of conceptual models of data base and data file dependencies at the provincial and municipal levels. Also, this information would be used in establishing functional models for a municipal land-related information system and a provincial digital topographic data base.

These models will be discussed in detail in papers to be presented later in the day.

CONCLUDING REMARKS

The municipal and provincial studies completed for this project are detailed and comprise hundreds of pages in several volumes. This paper only attempts to chronicle the methodoloy used to carry them out. In subsequent papers, the actual conclusions and key findings will be addressed more specifically.

However, it is hoped that this paper provides detailed background regarding the techniques and tools used in carrying out such a study. If the paper has been clear in this objective, and you find it useful for application in your jurisdiction, I believe the paper has provided a meaningful tool.

CHAIRMAN PANTING: Thank you very much, Jack. A very interesting paper. If any of you have not picked up the handout showing the models and the generic functions definitions, pick them up on your way back from lunch. They will be at the doorways here. It is now 12:15, so I guess we will see you at 1:30.

AFTERNOON SESSION — MONDAY, DECEMBER 12, 1983

CHAIRMAN PANTING: Well, notwithstanding my opening comment this morning, I think we are back on track. The next paper is a presentation on the Proposed Conceptual Model and Functional Model for Municipal Land-related Information Systems.

The construction and the description of models can be a highly technical matter couched in terms only the converted can understand. I am aware that a great deal of discussions has gone on between Jim Linders and Jack Dangermond on how to make this presentation so that people can understand

it and perhaps feel reasonably comfortable with it, and I feel confident that we will all benefit by that feeling of concern.

Dr. Linders, our next speaker, holds a Master of Science Degree from the University of Toronto and a Ph.D. from Imperial College, London, England. From 1961 to 1965 Jim was a lecturer at the Ryerson Polytechnical Institute in Toronto. From 1965 to 1969 he was a lecturer at the Centre of Computing and Automation, Imperial College, London. From 1969 to 1976 he was Associate Professor, Department of Computer Science, University of Waterloo in Waterloo, Ontario. In the period 1977 to 1982 Jim was Chairman and Professor, Department of Computing and Information Science at the University of Guelph. Jim has recently completed a one year sabbatical from the University of Guelph and during that sabbatical found time to serve on the Ministry User Needs Study Technical Advisory Committee and that puts him at the near end of John Kerr's 3,500 mile tether. He also served on the Technical Working and Interview Group in the User Needs Study. Jim carried out most of the interviews in the Ontario Ministries identified as having geographically referenced information systems. His past experience in computer assisted mapping and landmass data bases includes: automated cartography developments in the Surveys and Mapping Branch, Energy, Mines and Resources Canada, and membership in the Technical Production Team in Geographical Referencing for Surveys and Mapping Branch, Ministry of Natural Resources, and was the principal investigator for the Ministry's semi-automated mapping system development at the University of Guelph. Jim's paper is entitled: "Proposed Conceptual Model and Functional Model for Municipal Land-related Information Systems". Jim Linders. (Applause)

PROPOSED CONCEPTUAL MODEL AND FUNCTIONAL MODEL FOR MUNICIPAL LAND-RELATED INFORMATION SYSTEMS

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Abstract

Conceptual and functional models for a generalized municipal information system are proposed from information derived from a Municipal Land-related Information Needs Study. The models provide a data base perspective for structuring the land-related information needs of a municipality and are designed to assist in the implementation of spatial digital information systems for municipalities.

Introduction

The motivation for developing generalized models of land-related information for municipalities dates back to previous work and seminars. In the past two georeferencing seminars, it was clearly identified by participants that a substantial component of the landmass data resides within the domain of the municipalities. Much of this data is currently in a manual graphics format, however, there are moves in the direction of developing special purpose automated municipal information systems. The recognition of the existence of such large amounts of data required that before any provincial perspective of landmass data could be considered complete, it was necessary to initiate a comprehensive study of the land-related needs within the municipalities.

In the past, much of the interest in land-related data has centred around the needs of provincial agencies. This preoccupation has perhaps resulted in a lack of appreciation of the land-related data needs of the municipalities. As well, there has been little correlation between corresponding information sources within municipal, provincial and federal agencies. Even though limited studies have been carried out within specific municipalities, no concerted effort has been made in the past to correlate the municipal needs with those of the province with respect to land-related information.

At present, there is considerable interchange of land-related data between the municipalities and federal/provincial agencies. This information transfer is achieved using a variety of formats usually related to specific missions. For example, considerable land-related information is available through the assessment tape provided by the provincial Ministry

of Revenue. This is provided to the municipalities for municipal taxation purposes. Also, many municipal planning departments make use of land-related data from agencies such as Statistics Canada, Soils Canada, Ministry of the Environment, etc. The actual transfer of the data between agencies has not necessarily been simple. Consequently, there has been great desire to facilitate the transfer of land-related data between various agencies. By so doing, considerable redundancy may be eliminated and more timely information may be provided for use within the perspective of a management information system environment.

A major consideration in undertaking the study was to ascertain the extent for which there was a need for OBM data in digital format. At present, the OBM maps are available only in hard copy graphical format. However, there has been considerable demand to provide this information in digital format from a variety of potential users. The extent to which this data would be meaningful to the municipalities has never been fully understood or documented. As well, it is necessary to understand other parameters within the system environment such as accuracy requirements, scale, coverage, etc. However, the availability of topographic data in digital format may very well have its own problems; for example, generalized access for a wide variety of potential users.

There has also been a concern that many municipalities are now seeking digital solutions in an independent manner. Consequently, it was deemed desirable to attempt to design common standards before major systems are developed and put in place without the advantage of a common perspective. This is of particular concern if there is to be any effective data interchange between the municipalities and provincial agencies.

Many of the above concerns were addressed by the municipal user needs study. A conventional systems development methodology was followed in carrying out the study. In particular, the SPECTRUM system development methodology, as mandated by Management Board was used. Most of the information was collected through a series of interviews following a standard interview format. This information was tabulated and analysed and the findings summarized for presentation to other interested parties. From the results of the study, it was possible to postulate a number of models which describe the environment under which data is both stored, managed and manipulated within the context of municipal information systems. These models provide a generalized perspective on data handling and data flows between various data bases within a municipality and on their co-existence with provincial agencies.

Also, within the context of the study and the system development methodology, the models will be tested by implementing a number of pilot projects which are designed to provide a demonstration capability of many of the concepts addressed by the models. The objective of the pilot projects is to validate the findings of the study as well as to provide sample working environments of the proposed models.

Consistent with the system development methodology, a number of vehicles have been used to communicate the results and concepts of the study. Firstly, the interviews are available in terms of a set of structured reports which could be of assistance to municipalities contemplating

development of their own municipal information systems. These are supplemented by a number of other documents being developed which address specific issues within the context of the study, namely, OBM digital mapping standards as well as implementation strategies for the proposed models.

The perspective of this study has been to develop models for the use of land-related data in the context of municipal information systems. This has been done using a structured methodology in order that all aspects of the problem definition and proposed solution can be readily communicated to others.

Municipal Data Base Models

There are three types of models which are being developed for the municipality. These are as follows:

1) Conceptual Models - which depict the relationships between the different data bases within the municipal environment.

2) Data Models - which show the principle data items within each data base as well as all key values used for access.

3) Functional Models - which defines the characteristics of the operational environment.

There are a variety of options in terms of realizing a municipal information system environment. These options break down into the following classes:

1) Manual - in which the emphasis is on existing manual graphics as well as the associated manual files, such as for example engineering drawings, maps, schematics, etc.

2) Digital - which provides computer based solutions for handling information requirements. Digital files in conventional data processing maintain an organized collection of attribute values. For spatial data, digital files range in scope from simple positional co-ordinate data to complex structured files for maintaining spatial relationships (topology) such as those found in polygon based parcel systems.

3) Manual/Digital - in which a combination of the two technologies are used to realize an overall solution.

These options can also be further augmented by a variety of implementation strategies, specifically, for digital solutions. One perspective is to have a partial commitment to a digital solution, for example, such as the use of limited digital data files. This solution may also have a limited perspective in that the intent is to maintain only those files for which there is a very decided technological leverage.

A commitment to a full digital solution may need to be in itself evolutionary in that there is an incremental process by which a global solution is ultimately reached. Another alternative might be to seek a total digital solution in terms of a fully automated system. This alternative is likely to be of limited interest since such systems are still under development and as yet unproven.

In all cases it is important to recognize the need to build the appropriate knowledge base within a municipality in order to accommodate the change in technology.

Summary of Municipal User Needs Study Findings

The perspective of the municipal user needs study was limited to land-related information. The four municipalities studied provided a broad perspective of municipal needs and it is interesting to note that the conclusions apply equally well to all four. The findings of the municipal needs study can be summarized as follows:

1) It is difficult to separate out the land-related components from within a municipal information system environment. In this sense, the municipal data base environment must be seen as an integrated administrative data base.

2) A parcel data base is central to the operation of a municipal information system. In the study, it was clear that a substantial component of municipal administrative activity is based on a good parcel definition.

3) All of the functions requiring parcel maps can be satisfied with a limited accuracy parcel definition. From the study, it was ascertained that most parcel maps are used as schematics for the depiction of spatial relations. The spatial relationships are more important than the actual absolute positional accuracy of the parcel definition.

4) There are strong interdependencies between the data items within a municipal information systems environment.

5) Many data relationships are implicit and can be encoded for increased potential benefit. This implies that much of the information processing that is now done manually could be handled through automation.

6) There is a considerable potential for sharing data between the province and the municipalities.

From the above, it was clear that the perspective for realizing the municipal land-related information needs was best done in terms of a data base model.

Municipal Models

The information needs of a municipality can best be understood in terms of a number of specific models. Each model provides particular insight into the function and operation of a comprehensive municipal information system. Three models are presented, namely, a conceptual model, a data model, and a functional model. These are used to define the organization, structure and operation of a data base environment for operating a municipal information system. The models provide basic information for a data base design and as such are of potential value for system implementors.

There are a number of clear objectives in developing a municipal model, namely:

1) to facilitate the implementation of digital systems for land-related data;

2) to explore vehicles for the orderly and timely, bi-directional interchange of data between provincial agencies and municipalities;

3) to demonstrate the use of generic capabilities in building land-related information systems;

4) to provide guidance to municipalities and provincial agencies with regard to handling land-related information.

The models are seen as essentially a first step towards standardization. Each model provides a conceptual framework about the needs and dependencies of data within a municipality. In this sense, the model is used to identify common data interests between the province and municipality, and as such becomes a global objective towards which a municipality should be moving in realizing its information handling needs.

The models are designed to specify a shared data environment for use by all interested parties within the municipal and provincial context. Within the models, many of the data items and their interdependencies are identified.

Municipal Conceptual Model

The information needs for a municipality can be defined in terms of a number of distinct data bases, each of which contributes to a total municipal information system environment. Each data base is distinguished by a unique set of functions and as such has its own domain of capabilities and data dependencies with other data bases.

The conceptual model for a municipality identifies the component data bases within a municipal information system environment and their interrelationships. Each data base is unique in its own right with respect to the data which it maintains and the capabilities associated with the data. The totality of the data base environment is predicated on

the functionality of each individual data base as well as the interconnections between the various data bases. Each data base within a municipality represents a unique set of capabilities required for administrating some aspect of the municipality. The number of data bases actually implemented may well vary from municipality to municipality. As well, some of the data bases may be manual (for example, map bases, etc.), while others represent various levels of automated capability ranging from simple digital files to complex data base operations.

For each data base there are a set of files which are used in its operation. The number of files is open-ended so that the scope of each data base can readily be extended. There is a unique set of keys for referencing the data within each data base. In many cases data required from other data bases can be identified and referenced through the appropriate data keys.

It is important, within a data base environment, to eliminate physical data redundancy, hence, whenever the data is referenced the data must be accessed from its associated data base. The location of the data is known through the data dictionary and data directory. There can be considerable logical redundancy in that the same feature or segment can be referenced as part of other data entities as often as required. Hence, logically, a data entity may appear many times, although there is only one actual, physical encoding of the entity within the system environment. For example, a line segment as it appears on a map may be part of a river, as well as being a legal and administrative boundary. The data defining the segment appears only once, however, it may be referenced several times within the data base environment.

Within a conventional institutional data base environment it is common to distinguish three main data base types, namely, finance, personnel and facilities (resources). Finance and personnel are well understood, having evolved over time within conventional data processing. Some facilities data bases within a municipal environment deal with the land-related components and can be correlated with each other in a unique manner (e.g., by position, geocode, data item, etc.) as well as with financial and personnel data bases as appropriate.

A schematic of the conceptual model for a municipality is shown in Figure 1. This identifies the component data bases which have positionally related data items classified according to function, namely, geodetic, topographic, street, parcel and application data bases. Many of the data bases are administrative in function, however, there is strong dependency on a positionally based parcel definition. There may also be dependencies with other administrative data bases, for example, finance and personnel.

The principal focus of municipal land-related data bases centres on two main data bases, namely, the parcel data base and the street network data base. These two complementary data bases provide a basic fabric for the description of spatial land-related information. The street network data base may or may not maintain a complete definition of the road network and associated data including road alignments and street limits. It must, however, have connectivity of street segments between intersections as well as provide a topological framework for the street network.

MUNICIPAL CONCEPTUAL MODEL

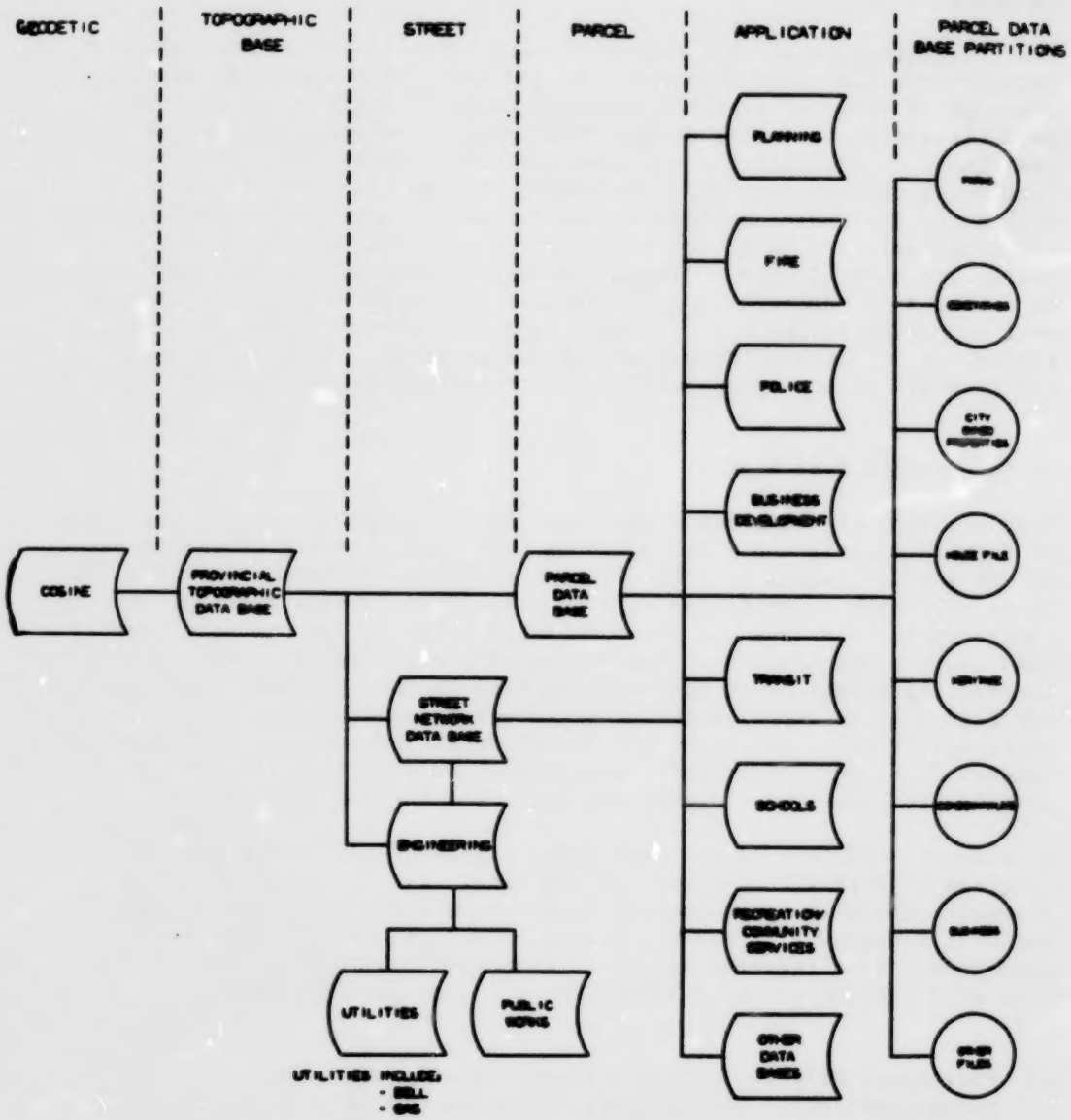

Figure 1

The parcel data base in turn is described in terms of the basic survey lot structure and ownership details.

The individual data bases identified during the study which make up a municipal data base environment are as follows:

1) Geodetic

The integrating theme of a number of data bases in the conceptual model is position and its various facets. At one end of the spectrum, position is recorded in terms of a highly accurate geodetic positioning network. A geodetic network provides an accurate frame of reference for relating all positional data within the municipality. At present, the data for all horizontal control (geodetic) monuments in municipalities is maintained within the provincial horizontal control survey data bank COSINE to which all municipalities have access. Currently, COSINE maintains only horizontal control network data, however, in time such a data base could be extended to accommodate both vertical (bench marks) control data as well as cadastral corners. In this capacity, COSINE would provide a fundamental positional data base for the province. The components of COSINE which relate to municipalities are available and are used locally.

2) Topographic Base Maps

Each municipality requires a basic set of topographic maps for depiction of terrain details and culture. Some municipalities are already covered by OBM maps at scales of 1:20 000 or 1:10 000 and in some cases 1:2 000. These maps have a particular role to play, specifically, for registering environmental overlays and other thematic data such as soils, climate, land use, vegetation, etc. The topographic maps are in essence a base for integrating a variety of land-related data for planning and engineering purposes. It is expected that the topographic coverage of each municipality conforms to the OBM Standards for purposes of compatibility between different topographic data bases. Only in this way will it be possible to correlate features and positions between data bases.

At present, OBM is a manual data base, although experiments are in progress to work with digital OBM map data. Within a digital OBM framework there is a taxonomy of features as first described by the National Topographic Standards Group. This has been extended to accommodate some features unique to the provincial scene. The digital data will consist of the following major components, namely:

A) Positional File for all referenced features shown on a topographic map. Each feature is maintained as a definition of exactly what is on the ground. This component provides positional definition for all features and as such, in conjunction with the feature classification, is of value within a digital spatial data base environment.

B) Symbolized File, which is a graphics file used to produce a map. This file shows symbolized features and is cartographically consistent so that all features are cartographically correct.

C) Digital Terrain Model. Even though there will always be a need to depict relief on maps, it is not so clear that the contour should be stored digitally. It is proposed to maintain a digital terrain model definition from which contours can be derived as needed. The digital terrain model will consist of traverses recorded at significant intervals. As well, land forms such as drainage detail will be recorded in stream mode using x, y, z co-ordinates. Access to a DTM provides a source of alternative data for those who require accurate land form data.

3) Street Network Data Base

Much of the activity associated with the running of a municipality relates to the street network. The street network is seen as consisting of several seemingly different levels of information.

Firstly, the streets are a logical subset of a topographic map. In creating the topographical map, streets are shown as they appear, from which connectivity (topology of the network) can be determined. The topology of the street network is essential for engineering and G.I.S. functions which are network related, e.g., traffic flow analysis, service network flow capacities, demographic analysis, etc. One particular aspect of the topographical street network data base is a street segment network, such as the U.S. Census DIME files, which is required for many G.I.S. functions. This file provides a planer graph model of the street network in terms of intersections and interconnecting street segments. The topology of the network is maintained in terms of all interconnections. Street segments also maintain address ranges and have the potential of storing a variety of data items (attributes) as may be required by specific applications.

A variety of other data may also be stored on the street network as may be required by each municipality. This would be done by associating the appropriate set of formatted data files with the street network components. Of particular interest would be details of curb lines, sidewalks, street hardware, horticulture (trees), structures (bridges, etc.), and buildings.

The street network also shares some data elements in common with the parcel data base, namely, the street limits.

4) Parcel Data Base

The parcel data base is seen as perhaps the most important single

land-related administrative data base within a community. At present, this data base consists in manual format of typically a "house file" and associated parcel maps.

This data base contains both definition and attribute information. The lot fabric defined in terms of a consistent set of survey co-ordinates, is maintained in a topologically based parcel structure. Each boundary segment is uniquely recorded and maintained in such a manner that all other data entities, which rely on the segment for their own definition, can "logically" reference it. For example, a parcel boundary definition is needed for the definition of two adjacent parcels. This same segment may also be part of an administrative boundary as well as any zoning boundary.

Conceptually, the parcel data base is seen as being made up of "parcel" data entities. Each parcel in turn is defined in terms of boundary position data and has associated with it a number of attributes which maintain information about the parcel. Typically, the following record classes (or relations) would be maintained for the parcel data base:

1. boundary position data
2. assessment data
3. permits
4. licences
5. inspections (schedules and site reports)
6. horticulture
7. services (references to engineering drawings)

The parcel data base can also be divided into a number of unique data base partitions, each of which may have its own set of unique attributes. The following minimal set of data base partitions on the parcel data base is envisaged:

1. house files
2. city-owned properties
3. commercial properties
4. condominiums
5. parks
6. cemeteries
7. heritage

Whereas the parcel data base may appear to be conceptually and logically simple, its implementation in terms of an automated system can be very complex, depending upon the degree of automation sought.

5) Engineering Data Base

The engineering data base is the natural complement of both the street network and parcel data bases. In essence, it maintains a plethora of information about the municipal land base. Traditionally, this has been viewed as a graphics data base supplemented with a variety of attribute information. Within an automated system, the same basic information must be maintained.

The three major components of the engineering data base are:

A. Graphics (maps, drawings, plans, etc.)

This includes: registered plans of subdivision; plan and profile drawings; schematic masters; site plans; etc.

It is expected that such graphics will be part of any fully automated municipal information system, although the manner in which the data is collected, stored and maintained may well differ in order to meet data base consistency and integrity requirements.

B. Inventories

Much of the information concerning the land base is maintained in terms of a variety of agreements, contract specifications and other legal documents. Most municipalities will maintain collections of information concerning:

subdivision agreements and inspections;
capital projects;
structures;
concrete/asphalt;
easements;
right-of-ways;
encroachments; etc.

C. Services

A substantial portion of the municipal engineering data base pertains to the services provided including location, status, maintenance records, etc. The services include storm and sanitary sewers, as well as water, electric, gas, telephone and cable TV. Most of this data base is shared in common with associated agencies.

6) Application Data Bases

Within the municipal context, there are a significant number of application area data bases which rely on the availability of land-related data as found in the parcel and street network data base. Indirectly, through these two data bases, the application data bases may reference data found in other related data bases such as engineering, topographic, geodetic as well as geocoded external data bases (e.g., Statistics Canada data).

Each application area can be viewed as maintaining their own data base or file system within a shared data environment, i.e., data bases could be quite sophisticated, such as the planning data base.

It is important to recognize that for most of these to operate effectively, it is necessary to have access, either directly or indirectly, to most other data bases within the municipality. Many enquiries or decisions require on-line access to timely information.

Even though the application area data bases may be developed independently, they must have a common perspective on the landmass data on which they operate.

Municipal Functional Model

The municipal functional model pertains to the operation of a municipal data base environment. The model in Figure 2 shows schematically the functioning of a municipal data base.

The co-ordination of activities is achieved through some form of monitor which may be in itself part of a Data Base Management System (DBMS) or may be a customized product developed for the municipal environment. The transactions define the activity which are to occur, e.g., adding, deleting or updating data elements of data entities within the data base (for example, change in ownership for a parcel), as well as locating, displaying and/or creating reports. In order for the system to operate, the data base requires access to a data dictionary which defines all valid terms within the data base environment and particularly those used in the query language. There is also need of a data directory which identifies the location of all data items within the data base environment.

The functional model is concerned with three main types of activities, specifically, data base load, data base access and update, and data base maintenance. Within a generalized type of environment, the user interface would be defined in terms of both a command and a query language. Some elements of these languages may be unique to an individual application area while others are common especially for G.I.S. processing. To assist with G.I.S. processing activities, both function libraries (including a map processing library, generalized graphics for maps and business graphics, polygon processing, etc.) and generalized utilities (including statistical analysis packages, report generators, etc.) would be required.

The data which is required for processing within this generalized environment would be derived from a variety of sources including the municipal data bases (parcel, street network, engineering data bases, etc.), external files such as Statistics Canada data and data files from the associated application areas. The actual manipulation of data is done within a work space using temporary work files as appropriate. Where access is required to large volumes of structured data, it may also be necessary to build and maintain indexes of data items (data entities and data elements) for rapid access. The output of this process is the generation of maps, reports and other data files as required.

Figure 3 depicts diagrammatically the process of data base load. The first step in the process is the creation or update of the data dictionary. A data base load utility would then accept application data

MUNICIPAL FUNCTIONAL MODEL

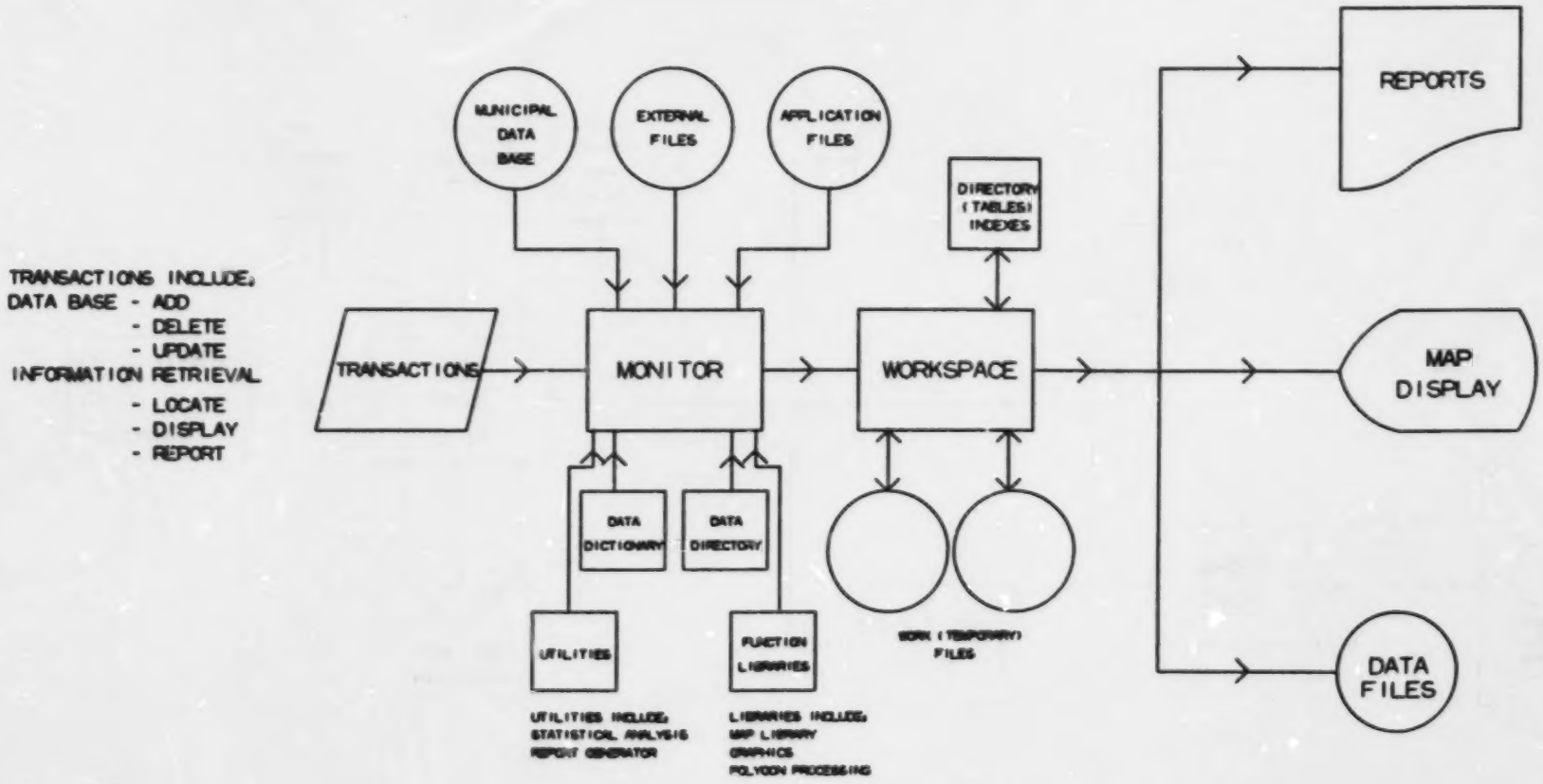

Figure 2

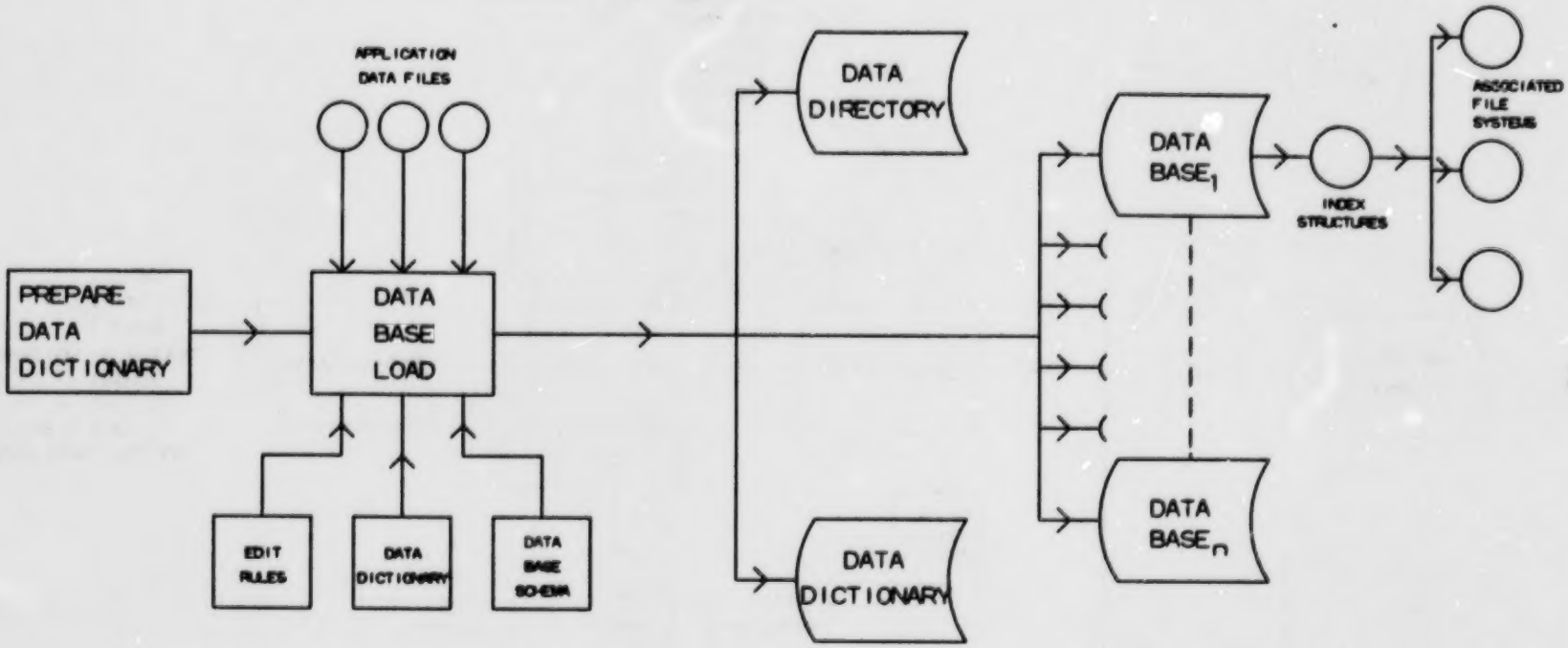
DATA BASE LOAD
APPLICATION DATA FILES
PREPARE DATA DICTIONARY
DATA BASE LOAD
EDIT RULES
DATA DICTIONARY
DATA BASE SCHEMA
DATA DIRECTORY
DATA DICTIONARY
DATA BASE$_1$
DATA BASE$_n$
INDEX STRUCTURES
ASSOCIATED FILE SYSTEMS

Figure 3

files as input for incorporation into the data base structures. As the data entities (parcels, block faces, etc.) are accepted, they must be validated against the data base schema which both identify the location of the data within the data base structure as well as specify any validation processing or consistency conditions. For complex spatial entities (e.g., road network, parcel fabric, etc.) an appropriate set of edit rules may be invoked as needed. The output of this process is an updated data dictionary, data directory, data base files and associated indexes.

Figures 4 and 5 show schematically the parcel and street network data base loads respectively.

Data base maintenance is a necessary function within any data base system. The exact nature of this task will depend upon the DBMS used, however, the basic functions to be provided include backup and recovery, archiving data, reformatting and restructuring the data base as well as performing periodic data base validation and consistency checking. Transaction logging may also be a requirement for data base reliability and integrity.

Other data base functions such as access control, security, audit trails, etc. are expected to be part of a general DBMS.

Municipal Data Models

The municipal data model will result from a full data base design during which time the ownership of individual data items will be decided. This is necessary in order to ensure that there is not unnecessary data redundancy. At this time, Appendix 1 lists the major data bases involved in a municipal information system as well as their primary and potential secondary keys.

Summary

The rationale for developing conceptual and functional models for a municipality was based on the need for a common data base perspective in the handling of land-related data and to provide a conceptual framework for a digital system implementation. Before an implementation can proceed, it is necessary to undertake a full data base design in the context of a specific data base environment. This in turn requires that a number of design decisions be made to define the system environment.

There are three major levels of system implementation which can be pursued. Firstly, a digital file system implementation can provide the necessary automated file capability for storing and referencing land-related data. The function associated with this approach is limited to automated information storage and retrieval.

At the next higher level of digital solution, a comprehensive landmass information system is realized in terms of a data base perspective. The

DATA BASE LOAD
PARCEL DATA BASE

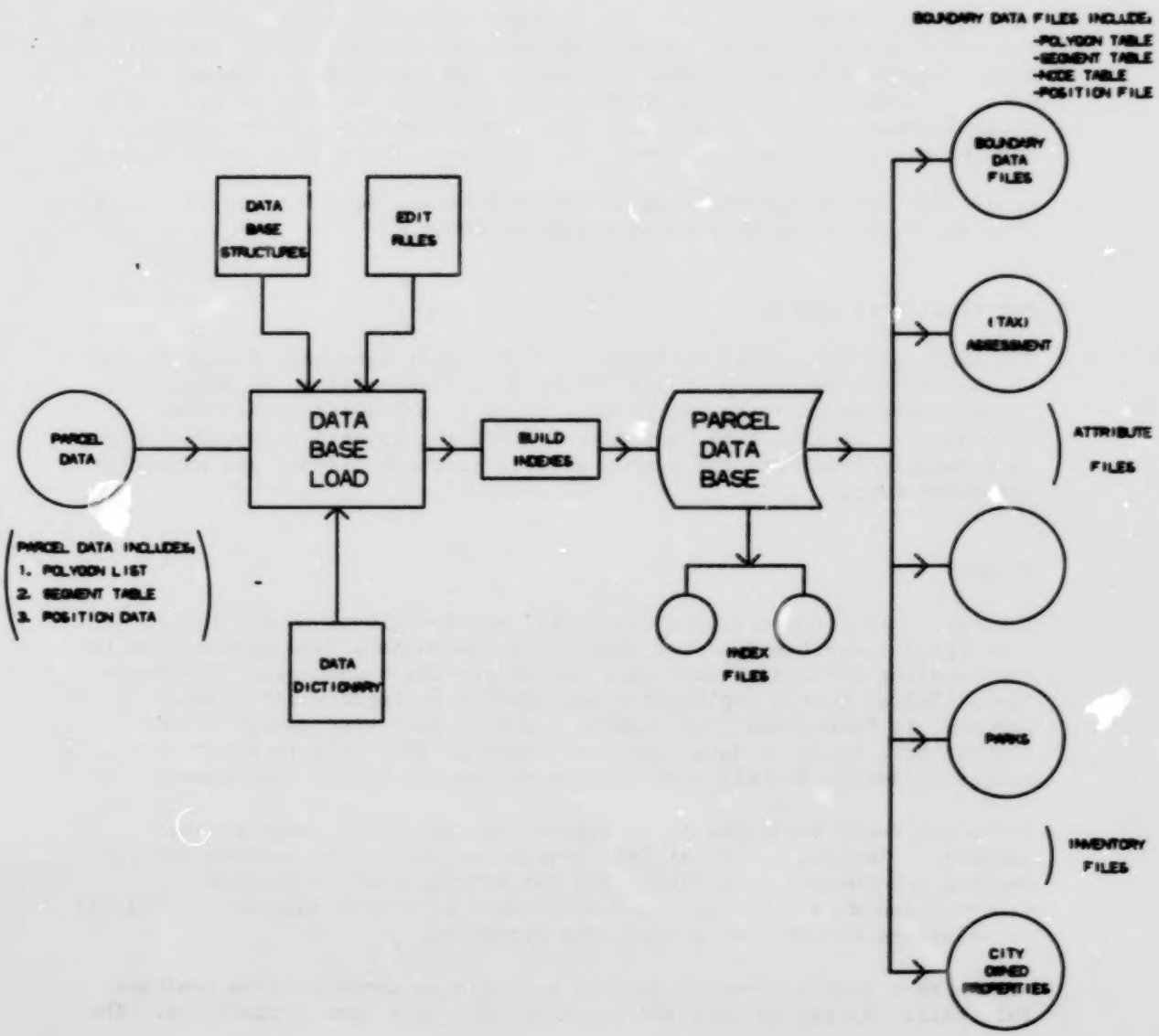

Figure 4

DATA BASE LOAD
STREET NETWORK DATA BASE

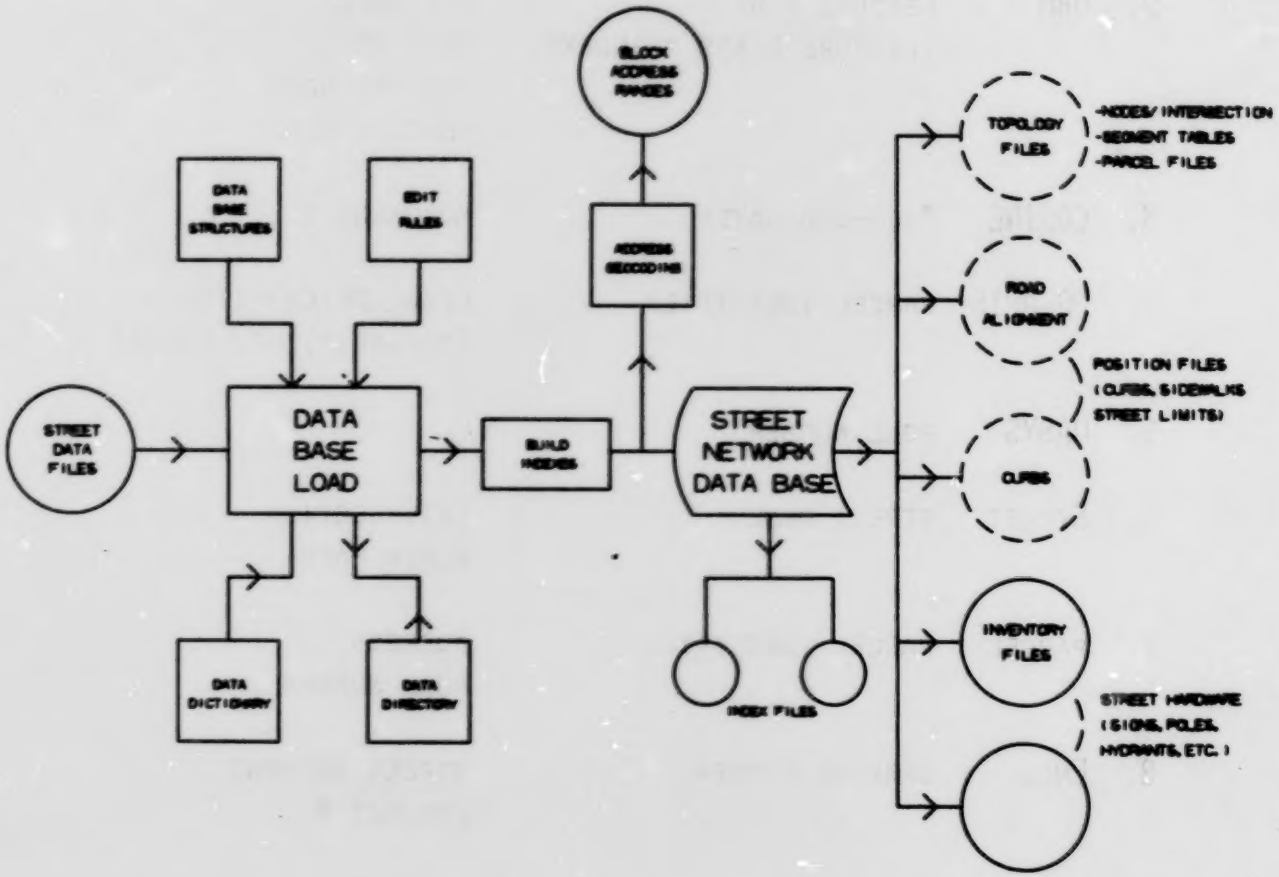

Figure 5

Municipal Data Bases

Data Bases	Primary Key	Secondary Keys
1. MTS	FEATURE I.D. (FEATURE CLASS + INDEX#)	MAP SHEET NAME FEATURE NAME
2. OBM	FEATURE I.D. (FEATURE CLASS + INDEX#)	MAP SHEET GRID CELL FEATURE NAME FEATURE CLASS
3. COSINE	* CO-ORDINATES	MONUMENT #
4. POLARIS	PARCEL IDENTIFIER	LEGAL DESCRIPTION (TOWNSHIP, LOT, CONC#)
5. OASYS	ROLL NUMBER	
6. Street	STREET NAME	INTERSECTION BLOCK FACE
7. PARCEL	PARCEL IDENTIFIER	ADDRESS ROLL NUMBER
8. Eng.	DRAWING NUMBER	STREET SEGMENT PROJECT #
9. Planning	PLAN # OFFICIAL PLAN SECONDARY PLAN	BYLAW # SUBDIVISION # SEVENCE # VARIANCE APPLICATION # SITE PLAN #

Appendix 1

Data Bases	Primary Key	Secondary Keys
10. Fire	POSITION (GRID CELL) FIRE CALL #	STREET ADDRESS BUILDING NAME
11. Police		DISTRICT BLOCK FACE INTERSECTION
12. Recreation	FACILITY NAMES	PARCEL I.D. LOCATION
13. Transit	FACILITY NAME	
14. Schools	NAME	DISTRICT ROUTE STOPS
15. Business Devel.	BUSINESS NAME	INDUSTRIAL PARKS PARCEL
16. Public Works	STREET PROJECT	FACILITY

Appendix 1 (continued)

data base may be implemented in terms of a DBMS with the function of both an administrative and land-related data base for realizing a municipal Management Information System (MIS).

A more advantaged perspective based on first realizing a municipal MIS is the creation of a municipal decision environment. Within the context, the MIS is further enhanced to provide greater function for modelling and automatic decision support.

It is clear that any digital solution for a municipal information system should be seen as an evolutionary process. Based on an initial commitment to the creation of a structured digital file system, G.I.S. functions can be added to build a full municipal data base. Through a process of incremental enhancement, further functions (both administrative and spatial) can be added to realize whatever level of system is needed for individual municipalities.

Many of the necessary prerequisites for a digital municipal data base are currently in progress, including digital OBM, conceptual and functional models as well as an appreciation of the commitment required. The potential of a digital municipal system will also be highlighted by the pilot projects. This approach should provide a common perspective on handling land-related data within the municipal/provincial environment.

I will stop at this point, but in the evening, we would like very much to pursue this subject in greater detail for those who would like to ask questions of me or of the other members of the team because, believe me, it was a team effort. I will take a good deal of the blame, but I would not take it all, and we would like very much to have your input. Thank you. (Applause)

CHAIRMAN PANTING: Time is marching by on us and we are coming up to coffee time, but we still have a few minutes and I would like to leave those few minutes for open discussion on the Models for Municipal Use. You heard Jack Dangermond before lunch give an overview of the Municipal User Needs Study and Jim has given us his discourse on the Proposed Models for a Municipal Land-related Information System, so it is appropriate that we take time now to throw the meeting open for discussion on the models proposed for municipal use.

What I am going to do Jim, is turn over the microphone to you so you can answer the questions as they come up. Who has a question?

No questions? Was that explained that well, that comprehensibly, that understandably? Would you rather break for coffee? Alright, let us do that. Let us break for coffee, see you in 20 minutes.

****** COFFEE BREAK ******

CHAIRMAN PANTING: We were talking about an open discussion on the models proposed for municipal use. Jim Linders is at our disposal. It is coming up 3:15 and it would be my proposal not to take more than 10 minutes in questioning. I think that in view of the fact that we have a workshop slated for this evening, that the highly technical questions be held over until that time. Those of you who are not able to attend that session tonight should take advantage of this opportunity to raise questions - no questions?

We discussed the Municipal User Needs Study and Municipal Models, now let us turn it around and discuss the provincial aspects of the User Needs Study and follow up with discussion on the Provincial Digital Topographic Data Base. Following these discussions we will have open discussion on the Proposed Model for the Provincial Digital Topographic Data Base. Our next speaker will be Jack Dangermond who will give us an overview of the Provincial User Needs Study. Jack. (Applause)

JACK DANGERMOND: I don't believe you, because I listened to a lot of people talking during the break and you had a lot of questions then, and so I just wrote down some of them. How many people know what a data base management system is, or how many don't, or how many do, that is better. The shy ones don't. That is less than half of you, so why don't you ask questions then? We talked for half an hour, or an hour about data base management systems. Data base management systems are a piece of software, magical software that moves us from a domain of handling files or data, stacks of data, into an environment where data is connected to function these tasks that we were talking about being generically, those sorts of tasks. I have about 14 others, and I am not going to go through each one, but just please notice where you know where you are at. And where you don't know where you are at, ask questions. It might be this room or something, I don't know what it is, we are not asking questions, questions like: What does this mean? What does it actually mean to a municipality? Does it mean anything this study or all of this research, or this compilation, what exactly does it mean to your day-to-day operation or where does it go in the next year? This notion of a data model or the notion of a conceptual model or a functional model, where does that actually fit into your working environment? Are there any of these things actually operating? I mean as we conceive of them in the study. No, it does not. People came up to me during the break and said: "We have all kinds of redundancy in our data. We are just a massive file system, we are not a data base management system and it will cost us millions to convert over to a data base management system. What are we going to do?", or what should you do now. How will the findings of all of this research be communicated to you and that is again some of the stuff that we want to talk about in the next day and a half that is left. What is the difference between a file system and a data base management system? Some of you are confronting that for the first time, so please ask those sorts of questions. Is it really a problem that we have data redundancy? Yes, it is. Why? Ask those questions, and I have some others. But you had better be asking them, because like Jim said, we think that everybody knows all about it, and we do not actually know all about it.

Q: Unknown Speaker: Who updates a data base and how is it updated?

A: Dr. J. G. Linders: Okay, good question. Clearly there is a need to update data bases, but this function is built into the data base design. The data base designer will design the data base so that all data base activity is transactions oriented. The data base will operate on-line, so it is not necessary to batch them up and run them overnight. If the information about a specific parcel is to be updated, this information will be reflected in all of the files that are affected. As I said earlier, there are two approaches. In the file system approach, if a single data item is changed, it is necessary to know of the consequences in other file systems. This is done by posting a message to all the other users (file systems) who are dependent on the information item. This is necessary in order to maintain corresponding changes in the associated data bases. The second approach relies on a data base system. If there is a good data base structure then minimal direct effort is spent maintaining it. It is necessary to go through a phase of perhaps validating it overnight to make sure that some of the relationships have not been destroyed, but the reason one pays big dollars to buy a data base management system is the expectation that the data base management system will alleviate the misery associated with maintaining the data base. Data base maintenance can be a tough problem, especially when there are a number of independent file systems, none of which are properly interconnected. The result is that it is usually necessary to update every file system within the data base which is affected by that particular piece of information on the update. Again, it should be emphasized that logical redundancy is permitted but physical redundancy within the data base should be avoided.

JACK DANGERMOND: It turns out that those 33 generic functions are the basis for the update. You see, they are the transactions that when you boil it all down they actually update the data base. So when you talk about taking all of this pile, let us think of it as a pile of spaghetti. It is a nice way of looking at the data, just a big pile of spaghetti. A data base management system locks that data, the pile of spaghetti, in the function so that they are one and the same in this piece of software, or they are interacted. An application for a permit may first draw information from the data base. We have a function like a generic function called "give me a permit". A guy comes in, he fills out a form, it is entered in. There is some data that comes back; there are some rule models that are perhaps operated on and that permit tracks through the municipal environment until somebody says: "We will approve it". When it is approved, something is tagged in that "data base", another piece of spaghetti is added or some new linkages or some new relationships are established which say the data base is updated, because now there is a permit issued and when there is a house built on that particular lot, you know there is a certificate of occupancy permit which is issued. We now have that entered into the machine. In other words, the data base takes care of itself. In Los Angeles, the first city that we examined this way, we found that there were 42 sets of parcel maps being independently maintained in the City and County of Los Angeles, and over the same geographical area, I should say. So there were tremendous amounts of redundancy. Why did the redundancy exist, because everybody wanted their maps just slightly different, but a lot of the basic structural

characteristics were the same.

There was another principle of data base management systems that Jim pointed out, i.e., they attempt to separate the logical view of the data from the physical view of the data. The logical view of the data might be the way you and I would see it, a particular map. We see it symbolized or we see a particular set of data items or relations on a CRT, maybe there are 47 different data items in the physical structure of the data, but the way you and I only want to see it is three items at a time, because we are only interested in those three. So the software enables us to view logically only those three. It does not mean we have to separate those three and store them on a separate file, like a file management system would be. It means that we build a bridge to the physical data which says we only want to see those three items. It is separating the logical view, the user's logical view about the way it is from the way it is physically embedded in the system.

Q: Unknown Speaker: For a municipality with a large number of files, do we have to start from scratch or can we do something with the existing files?

A: Dr. J. G. Linders: Again, I would say you would convert in the same way that I suggested. There is a need for a data base load phase whereby, if we are going to build a parcel data base, we would expect the contractors to provide us with at least three different files:

i) the parcel file, defined in terms of the boundary segments;

ii) the segment file, defined in terms of the end-points; and

iii) the position file which is really the co-ordinate data that relates to the ground.

For the case where there is an existing data base, or an existing file system, the first thing that must be done is to agree on the data base model. Then it is necessary to agree on the DBMS you are going to use, along with the appropriate data structures. It is then a massive data processing job of bringing in the files as input and rebuilding a data base from the existing files. It certainly can be done, and this is the way I would do it. It is not a hopeless task and one need not start from scratch. One of the concerns that we had in dealing with the municipalities is that we must be sure that we do not do them more harm than good. So whatever data they currently have, we will have to enhance and show them the path to building and maintaining the associated data bases. In light of the fact that they are not going to go out and attract top computer scientists, we have to leave a structure in place that they can conveniently work with and which can be maintained without requiring the type of competence that is not really available, nor readily available, in the marketplace.

JACK DANGERMOND: Two additional items on that. One is a lot of the cost in building the data bases, the actual automation phase itself, so for those files which are already automated moving into a data base

environment, the cost is not extensive. It is the building of functions around those which are often embedded in FORTRAN programs, special purpose sorts of things that you transfer into a data base environment that is a little more costly. So much of that is so much simpler in the data base models that we are seeing coming out now so that costs, as Jim mentioned, are substantially less.

The other item that Jim mentioned a moment ago was something called "structure", that is structure between all of the various different files. I will show you two little crude diagrams that helped me visualize structure. They do not tell the whole story of the structure but they begin to tell me some of the ideas.

A flat tabular file might be a standard element of a file system. In this case: street address, parcel number, roll number, etc. Again, just diagrammatically how one might have a set of common keys as might be indicated in this parcel master index with relations between other tabular files giving some kind of structure to these independent, conceptually anyway, files. So that one item can be related to an item in another table by way of common keys. You want to add to that Jim? Another question. Yes?

Q: Unknown Speaker: How does one choose hardware, or do you choose software first or together?

A: Dr. J. G. Linders: Which comes first, okay, it is the chicken and the egg paradox again. I do not like the idea of first choosing hardware. I would prefer to think that whatever models are proposed are technology independent. As technology changes, the data base does not change, since the models have not changed. The data base structure remains invariant and I do not think that hardware has anything to do with the data base design. I think that the more important decisions that have to be made are, for example, which data base management system do you use. I had some foils which I did not get to, saying that there are basically three data base structures that are in the marketplace. Firstly, there is a hierarchical data base model, secondly, there is a network data base model and, thirdly, there is a relational data base model. There are some other variations too for those who are computer science specialists. There is a set theoretical model or an entity set model but these are a little more esoteric. There are also some functional models as well. My view is that, first of all, it is necessary to agree upon a data base model, something like what we have done which can be expanded to accommodate new needs. Then it is necessary to do a full data base design and this is done with some specific data base management system in mind. There are clearly some real trade offs and if you are to do this properly, you should seek the advice of an expert. This is because it is very hard to restructure some data bases. If a network model, for example, is used to build a data base and then it is necessary to put a few more relationships into it, then this normally means that it is necessary to restructure the whole data base. These are the sort of things that go on into the wee hours of the morning for those people who have network models. Some models are much more modular and extensible, and permit the addition of more functions and more fields (attributes), as well as the addition of data items as necessary and these can be done on the fly. Sometimes you

may not have a choice since the choice may be dictated by a particular piece of hardware. Some municipalities, for example, have IBM or UNIVAC equipment (I know of at least two municipalities that I have had contact with, who have UNIVAC equipment); possibly the choice of data base management systems is quite limited. It is necessary to carefully evaluate your options in terms of your objectives after which a decision can be made. You may require some input from a technical expert for a short period of time to assist in hardware/software decisions. I hope I have answered the question.

Jack Dangermond: We have one more question, right here.

Q: Dick Groot (EMR): What is topology? Who defines topology for a provincial/municipal system?

A: Dr. J. G. Linders: He is a friend of mine, I shall go first. Well, first of all, topology means structure and implies relationships. This is a mathematician's perspective. For the normal user it is appropriate to think in terms of data organization and data structure.

Who defines topology? The topology should be defined by the function. If there is a particular need that has to be recognized or be built into the data base, the topology will be dictated by the function expected of the data base. That is to say, if you pick the wrong topology you may pay a big price in terms of processing. This is essentially the difference between the file system approach in that whenever somebody wants something different done, it is usually necessary to write more software in order to meet the need. If there is flexibility built into the data base query language, and if there is sufficient embedded topology (namely, spatial relationships), it should be possible to meet all of the needs that are expressed by the user community through the query language.

Who defines them? Well, in the case of the municipalities, we hope that we will take a first crack at this and we will provide data base structures to the municipalities to give them some guidance. On one of the foils it was suggested that one of the reasons for the models is to provide guidance and direction in a technology-independent way. All the needs that we could anticipate from the municipalities can be realized by structures that we know can be built into existing data base management systems. For the provincial and federal scenes the situation is a little different, primarily, because "the concrete has settled", and many of the users are already locked into data base management systems and data base structures. This eliminates some of the flexibility and hence it is somewhat more difficult to make those kinds of changes. The municipalities are fortunate in a way for two reasons. One of which is that most of them have not even started. The second thing which is really important is that all of their mandate is literally within one office. The CAO (Chief Administrative Officer) in the last analysis has the biggest hammer. He can bring it about. It is harder to bring about change or dictate standards in the provincial scene. Each user has his own mandate, and is set about doing his own thing so that the need for co-operation is not as obvious as it is in the municipal scene. The municipalities are in an ideal position to do something, and if they take the right approach (hopefully this is what we are advocating), they will

be moving in the right direction. They should get some very positive results with minimal expenditure and, hopefully, within a meaningful timeframe I would expect; like something has to happen literally days after they start. The visible evidence should be there. You may want to add to that Jack?

JACK DANGERMOND: Maybe a subset of topology is one which we refer to in mapping as a set of topological relationships between graphic entities expressed on a map and they are commonly found on two sorts of maps. One is network maps, like stream maps or road maps, then we divide those into typically arcs and nodes; nodes where three or more arcs come together like confluences of streams, and we identify the relationship between arcs, these line segments or stream segments and these intersections with notations in a table, like what arc connects to what node connects to what arc connects to what node so that we can do things like stream modelling through the network using a topological structure. Similarly, transportation people use a street map which many of us think of as a graphic display on a topographical map of streets but they use it in an arc-node, arc-node, arc-node relationship to simulate transportation movement, like many of those network applications that I showed you earlier. They use as a fundamental base, connectivity of the network to know what link is connected to what link so you can do time-distance districting or optimal path selections.

In a polygonal map we look at arcs that make up a polygon and we look at the right side of an arc and at the left side of an arc and we say these point to a polygonal file of attributes which might be in a forced management case. A whole series of relational data items that tie to the actual polygon. Why do we introduce topology in a map? So that we can do certain types of analysis that we cannot do in just a graphics only domain. There are a number of other reasons, particularly, those associated with the cadastral mapping area involved looking at relationships between one parcel and another parcel, again adjacency studies and also those with respect to control so that as we change control we know what is happening to the topological edges of the parcels. Yes, Jim.

DR. J. G. LINDERS: This is a foil which I pulled from the pack that I was going to talk about. It deals with the notion of a model. A model is in essence an abstraction. A model is used to emphasize relationships; a model is not concerned about a specific technology, but rather about the relationships which are technology-independent. In our models, the emphasis is on sharing common functions. The model is in essence an abstract entity, and this is truly a data base perpective. Most of us work in a data base world today, except that it is a manual data base. The difference between a manual data base and a digital data base represents a big gap to overcome. I believe the technology has reached the point now where this is meaningful and practical. This can be seen in industry; perhaps not so much in municipalities because government people are much more conservative. Also perhaps the budget has not been there to facilitate this transaction. Some of the model characteristics are:

a) it must be modular so that we can extend it in both scope and extent;

b) it is the generalization of needs; and

c) encoding of a set of abstractions.

In fact, the models that we talked about have to be expanded, ultimately to the point of getting a data base design from them. We talked about overviews and the notion of peeling onionskins back until one gets to a very detailed set of information which would be the implementation. This is the conceptual framework for design and implementation.

JACK DANGERMOND: So, maybe another perspective would be that we are moving towards data base management systems in our more modern approaches to data management. In the '60s and '70s we did not have the sophisticated tools we have today. Everybody maintained their own data. They maintained the actual physical data on cards or on tape or on disk records. A lot of file management functions existed. Now the user is being relieved of some of the associated burdens by using so-called data base management systems. One of the young fellows that works for me thinks of data base management systems as a big garbage can you just throw the data in. There is a little monkey that sits on the outside of the garbage can which you tell what you want and it goes in and digs around the garbage can and brings it back to you. You do not have to remember where in the garbage can you keep your data or how it is filed or how it is managed. So we are becoming more modern and one of the functions is monkeys. (Laughter)

Another fundamental question that was asked that I will answer promptly and we will get on with the rest of the presentation, was what does all of the work that we are doing here mean? It is a set of research that one can build on. Does it tell you how to spend the next $100,000 tomorrow? No, it does not. It does, however, give you some clues particularly in the municipal model about the characteristics that one should look for when developing and implementing a modern land based information system.

FINDINGS REGARDING

A CONCEPTUAL MODEL OF A MUNICIPAL DATA BASE

AND IMPLICATIONS FOR SOFTWARE DESIGN

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ABSTRACT

This paper offers a new perspective on the components and interrelationships among land and geographic-related data which are used in a municipality. The various categories of land-related data and how they interact to form a municipal data base are described. In this paper, these various data components are identified, as well as the municipal tasks which generally make use of them, the types of generic software procedures which make them usable in an automated form, and the interrelations among them which must be understood as a basis for municipal data base design. The appendix to this paper provides a description of generic data management procedures which may be invoked in response to and support of this conceptual model and its implementations.

INTRODUCTION

Numerous jurisdictions have attempted to automate segments of their operational and procedural functions over the past several decades. These wide-ranging efforts have employed a variety of tools from the data processing community. One category of these attempts is associated with the automation of land and geographic-related information.

Various communities have attempted to automate particular types of land and geographically related information for individually selected municipal operations. For example: public works departments have attempted to automate plan and profile drawings, or maintain engineering drawings; planning departments have made attempts to automate parcel maps; environmental planners have attempted to automate environmental overlays for land suitability/capability; tax assessors and other municipal agencies that use parcel level data (such as zoning and building inspections and so forth) have attempted to automate a municipal tabular file of land-related data; and a variety of agencies working with street networks have attempted to work with geographic base files to abstract the street network for address matching, census mapping and related kinds of applications.

To date, the implementors of these various kinds of automated municipal applications have been generally handicapped by a lack of a full understanding regarding a municipal data base model which generically describes the various components commonly found in a municipal data base. This paper provides a description of these various categories of data and

how they interrelate with one another to comprise a municipal data base. The paper summarizes the results of an indepth study which applied a rigorous scientific methodology and approach to the identification of a municipal data base model. The findings, which were intuitively understood in the past, are now substantiated on the basis of the scientifically documented methodology which was undertaken. The purpose of this presentation is to provide a tool for designers and implementors of such systems so they can better understand how various hardware and software tools, as well as data base concepts, relate to the overall data model that exists for the typical municipality.

In describing this municipal model an effort has been made to isolate it from any single municipality; therefore, the model is presented without regard to organizational structure, institutional context, or the way that entities are implemented within an existing municipality.

BACKGROUND AND BASIC CONCEPTS

This conceptual model has evolved over a number of years through research conducted in the City of Los Angeles, California, the City of Anchorage, Alaska, Santa Cruz County, California, Clark County, Nevada, and most recently through an extensive scientific research and application project sponsored by the Provincial Government of Ontario. It was through this last effort that the conceptual model became clear and its form crystallized as it appears in this paper.

The Province of Ontario experience involved extensive interviews by a research team which examined four selected municipalities within the Province of Ontario. For each municipality, all of the departments which dealt with land-related information were interviewed extensively in terms of their mandates, their organizations and responsibilities, the tasks which they perform, the systems and data bases that they utilize, their existing data sources, and also their potential for use of geographic information systems. The Ontario effort involved numerous on-site interviews with each of the relevant agencies, as well as analysis of agency functions related to various ways that hardware, software and data bases could be used to their maximum potential.

From this basic research in Ontario, an extensive list of categorical tasks were identified, then generalized into a set of generic tasks common within municipalities. For example, generic municipal tasks include street addressing, building permitting, zoning subdivision inspections, and so forth. Table 1 lists thirty-three observed generic municipal tasks.

Table 1

OBSERVED GENERIC MUNICIPAL TASKS

Ongoing Procedural	Ongoing Managerial
1. Acquire and Dispose of Property	17. Conduct Land Use Planning
2. Process and Issue Parcel-related Permits	18. Conduct Engineering Design
3. Perform Inspections	19. Conduct Drafting
4. Provide Legal Notification	20. Conduct Title Searches
5. Issue Licences	21. Perform Tax/Fee Billing Collection
6. Conduct Street Naming	22. Create and Manage Mailing Lists
7. Review Site Plans	23. Allocate Human Resources
8. Review Subdivisions	24. Perform Facilities Management
9. Create Street Addresses	25. Perform Inventory Management
10. Perform Event Reporting	26. Perform Resource Management
11. Conduct Dispatching	27. Conduct Weed Control
12. Perform Vehicle Routing	28. Perform Map Management
13. Conduct Traffic Analysis	29. Conduct Drawing Management
14. Conduct Facility Siting	30. Perform Data Base Management
15. Administer Area Districting	31. Conduct Development Tracking
16. Administer Zoning By-Laws	32. Disseminate Public Information
	33. Respond to Public Enquiries

Municipal functions or tasks, and the types of data which support them comprise the vital elements of municipal operations. An examination of these generic tasks, together with the manual and automated data bases which are used in support of these functions, provide the fundamental framework upon which to build a "conceptual model" of geographic data entities and their relationships in a municipality. This understanding may then be directed into data base and information system design, and implementation planning.

Modern principles of data base management suggest that building a data base model may help to minimize or eliminate redundancies of data and operational function, and establish data entities and items which interrelate with each other (so that transactions which occur in the data base automatically update not only basic data entities but also the related information on which the data base is dependent).

A data entity, as it is termed in this paper, is a data source, such as a parcel map or a parcel attribute file. Each data entity is comprised of a number of data items such that, for example, one item in the parcel attribute file might be the area of a parcel. A descriptive summary of these components and their interrelationships is provided in the sections which follow.

THE CONCEPTUAL MODEL

In a conceptual sense, there are ten or more data bases in the municipal data model. Each of these may be conceived of as containing a series of data files, such as maps and tables of attributes related to maps. The ten basic data bases are as follows:

1. Base Map
2. Environmental Overlays
3. Engineering Overlays
4. Plan/Profile Drawings
5. Parcel Maps
6. Parcel/Street Address Tabular Data
7. Area Tabular Data
8. Street Tabular Data
9. Street Network File (geographic base file)
10. Area Boundary Maps (administrative boundaries)

Each of these different data bases contains data about geographic variation and status, which are commonly used to carry out municipal activities. However, some of these are used at much higher rates than others. Findings from municipal studies to date strongly indicate that the majority of municipal transactions are associated with the land parcel or street address tabular data. For the broadest range of municipal applications, the tabular format is more efficient. Other data bases, such as plan and profile maps, are used only occasionally in some of the engineering-related functions.

Figures 1 and 2 illustrate the interrelationships between these 10

MUNICIPAL CONCEPTUAL MODEL

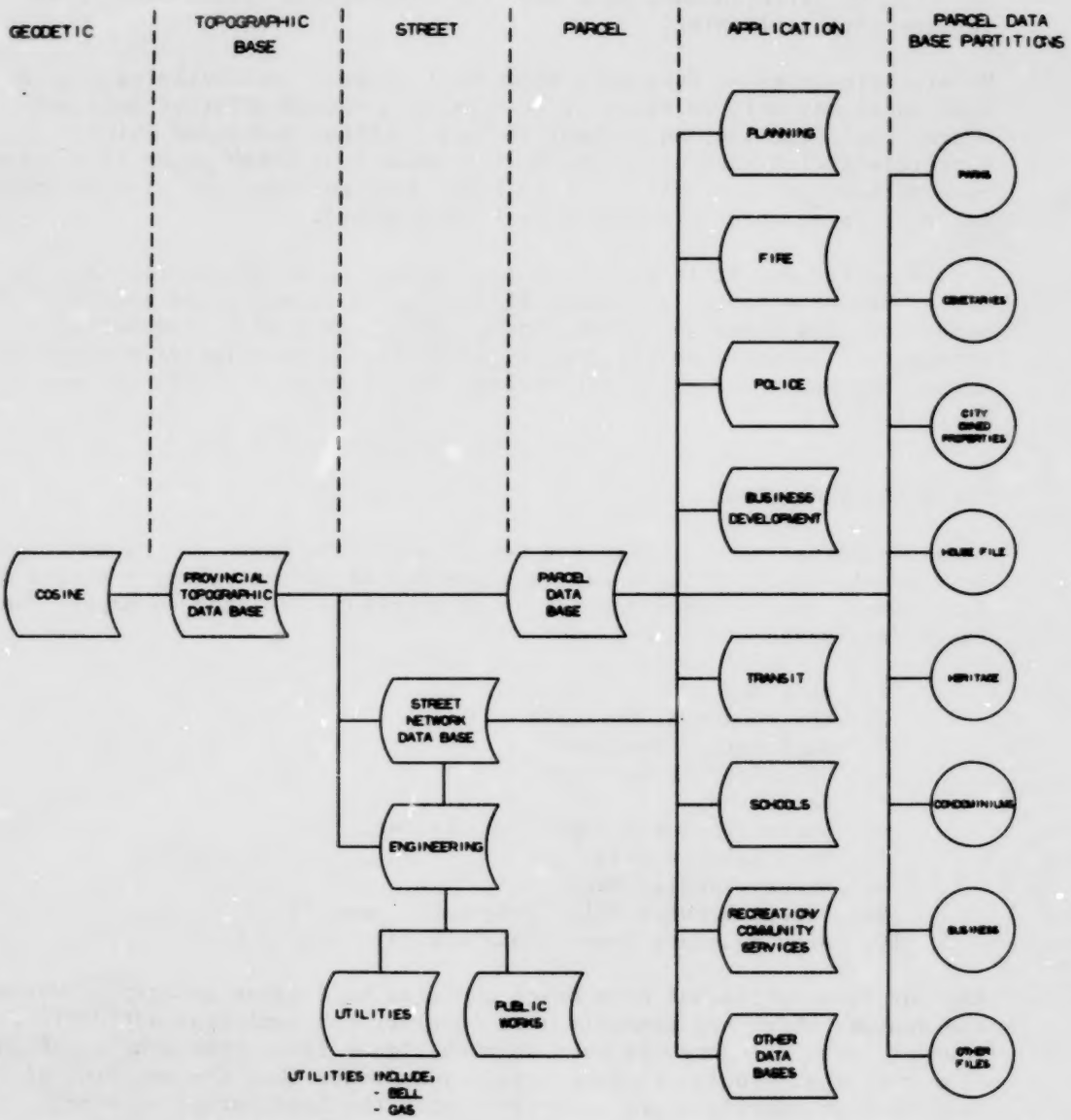

Figure 1

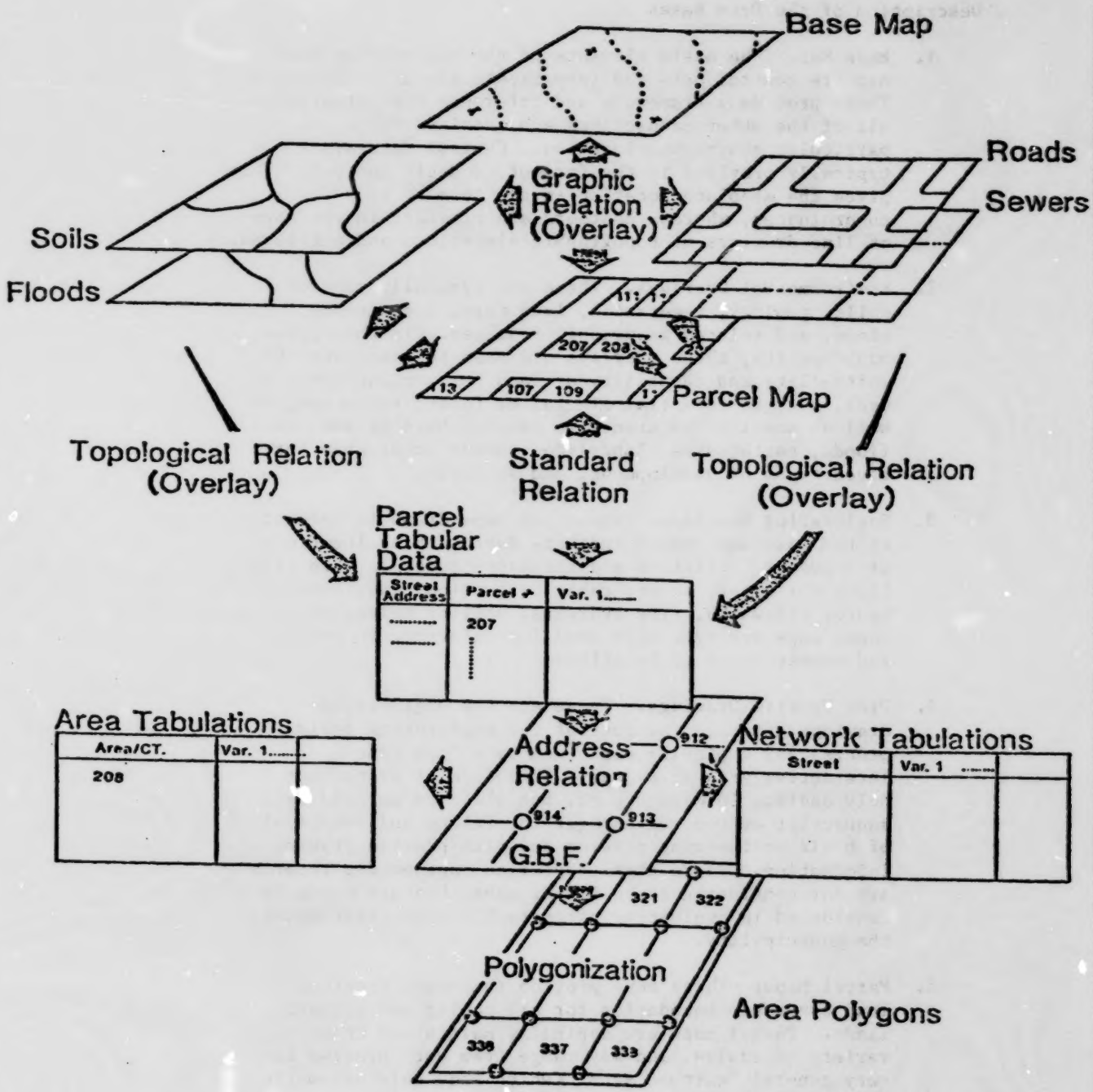
Base Map
Roads
Sewers
Graphic Relation (Overlay)
Soils
Floods
207
208
13
107
109
Parcel Map
Topological Relation (Overlay)
Standard Relation
Topological Relation (Overlay)
Parcel Tabular Data
Street Address
Parcel #
Var. 1.....
207
Area Tabulations
Area/CT.
Var. 1.....
208
Address Relation
912
914
913
G.B.F.
Network Tabulations
Street
Var. 1 .....
321
322
Polygonization
Area Polygons
336
337
333

Figure 2

different classes of data. The figures also indicate ways in which geographic information tools would be invoked to establish these relationships.

Description of the Data Bases

1. Base Map. The basic elements of the engineering base map are control data and topographic elevation contours. These provide a framework and reference for integrating all of the other manuscripts and overlays for a particular geographic location. Control data are typically provided in the form of geodetic control. This gives the absolute location in the form of x, y co-ordinates, whereas contours are provided in the form of line drawings of topographic elevations and altitudes.

2. Environmental Overlays. These are typically maps of soils, geology, vegetation, land form, hydrography, slope, and related geographic features. In the typical municipality, these overlays are used to associate the suitability and capability of land for various types of uses, such as potential mineral or forest resources, as well as possible reference to natural hazards such as floods, earthquakes, landslides, areas unsuitable for given types of development, and so forth.

3. Engineering Overlays. These are maps drawn in reference to the base map, which indicate data such as locations of roadways, utilities and infrastructure, layouts (i.e., lines for water, sewer, cable television, gas, electric, hydro, sidewalks, fire hydrants, utility poles, etc.). These maps are typically used for reference in grading and construction of facilities.

4. Plan Profile Drawings. These are the engineering drawings generated as part of the engineering design process and typically performed by a "cad type" interactive graphic system. This type of system not only assists in design work, but also can be used as a manuscript or records manager for filing and retrieval of basic engineering drawing and plan/profile drawing information. These highly detailed engineering records are not considered to be G.I.S. maps, but are normally considered in evaluating cartographic activities within the municipality.

5. Parcel Maps. These maps provide the basic drawings of land ownership boundaries for all public and private lands. Parcel maps are typically maintained at a variety of scales, and may range from very precise to very general "cartoon maps" (which show only schematic layouts of the basic land cadastre). Parcel maps are

commonly related in some manner to legal description documents which typically constitute the record for describing boundary ownership for a given parcel (e.g., metes and bounds descriptions).

6. **Parcel/Street Address Tabular Data.** This data typically includes a variety of tabular data sets associated with the parcel. In cases where buildings are actually constructed, these parcels are typically assigned street addresses or site addresses which correspond with the tax block and parcel type designation commonly used by the tax assessor.

   Parcel tabular data is typically one of the central data bases used for supporting operational activities within a municipality. Against this data base, a variety of activities occur (for example, in the areas of subdivision of land, zoning, building permits, and so forth). Therefore, it is typically maintained as a current file, often implemented with distributed processing terminals to a variety of agencies.

7. **Area Tabular Data.** This data is typically comprised of a variety of tabular data bases about blocks, census and immigration areas, and a host of other administrative areas summarized into aerial unit tabular form. These data could include police statistics on events, number of students by district area, and statistics from the census on relations, population and housing, health statistics, and so forth.

8. **Street Tabular Data.** The street tabular data entity includes a variety of statistics associated with the street link, (typically, a link running between two assigned nodes or street intersections). This tabular data may relate to road conditions, size, or maintenance quality; event data such as accidents or crime; or population and housing characteristics associated with properties which abut the street links (such as the number of single family homes on a street face and their maintenance quality, the number of students living on a particular street block, or the amount of garbage requiring pick up).

9. **Street Network File (Geographic Base File).** This is typically a topological street network file providing intersection numbers, street names, link numbers of each street, address ranges of the streets, and the polygons on the right side and left side of each street. This street base file provides a linkage between address data and street faces that surround a municipal block. By using the concept of address geocoding, parcel data may be matched with the street network to create street tabular data.

10. **Area Boundary Maps.** Area boundary maps are co-ordinate boundary data bases which define the polygon outlines of blocks, enumeration areas and various administrative boundaries such as school districts, police districts, census summary districts, zip codes, and so forth. These maps correspond directly to the area tabular data described above.

Table 2 presents an accounting of the ways in which particular generic municipal tasks are observed to use the ten identified data entities in the municipal model.

The types of data which municipalities generally require typically exists in one or more existing agencies. However, studies conducted by ESRI have found that often data desirable in one agency (e.g., street network data for ambulance dispatch) resides in and is maintained by another agency (e.g., roads maintenance or planning). Such data is not readily available in the format or location necessary for reuse or data sharing. Thus, duplication of effort in data collection, storage and maintenance are found. The integration of land-related data entities for a given study area into a single unified system will eliminate duplications of effort and cost, and result in greater economies and efficiencies for the jurisdiction(s) involved.

Description of the Basic Procedural Techniques Required

To create the necessary interrelationships among the data entities just described, four basic types of procedural software techniques are employed. As illustrated in Figure 1, these basic tools are: graphic overlay, topological overlay, address geocoding, and polygonization.

Graphic overlay involves overlaying several manuscripts atop one another to plot selected map elements which coexist at the same geographic locations.

Topological overlay involves the joining of geographic elements from two or more separate files to create an "integrated" cartographic file. This new file consists of intersecting of common elements of the selected data files (e.g., the joining of cartographic elements via polygon overlay to form new tables of attributes).

Address geocoding is a procedure through which street address data and street network data are associated. Using a G.I.S. matching capability, street addresses may be matched with a range of addresses assigned to street links.

Polygonization involves the chaining together of link segments (such as street network links) to form district boundaries comprised of related polygons (i.e., administrative districts for schools, police, census or

DATA REQUIREMENTS

POTENTIAL USES	BASEMAP	ENVIRONMENTAL OVERLAYS	ENGINEERING OVERLAYS	PLAN/PROFILE DRAWINGS	PARCEL MAPS	PARCEL/ADDRESS TABULAR DATA	AREA TABULAR DATA	STREET NETWORK FILE (GBF)	STREET TABULAR DATA	AREA BOUNDARY MAPS
1 Acquire and Dispose of Property		X			X	X	X			X
2 Process and Issue Parcel-Related Permits		X			X	X				X
3 Perform Inspections	X	X		X	X	X		X		
4 Provide Legal Notification	X				X	X		X		
5 Issue Licenses	X									
6 Conduct Streetnaming										
7 Review Site Plans										
8 Review Subdivisions	X	X	X	X	X	X		X		
9 Create Street Addresses					X			X		
10 Perform Event Reporting		X			X		X			X
11 Conduct Dispatching					X	X				
12 Perform Vehicle Routing		X			X		X	X	X	X
13 Conduct Traffic Analysis		X	X					X	X	

Table 2

DATA REQUIREMENTS

POTENTIAL USES	BASEMAP	ENVIRONMENTAL OVERLAYS	ENGINEERING OVERLAYS	PLAN/PROFILE DRAWINGS	PARCEL MAPS	PARCEL/ADDRESS TABULAR DATA	AREA TABULAR DATA	STREET NETWORK FILE (GBF)	STREET TABULAR DATA	AREA BOUNDARY MAPS
14 Conduct Facility Siting	X	X	X	X	X	X	X	X	X	X
15 Administer Area Districting					X	X	X	X		X
16 Administer Zoning By-Laws		X	X		X	X	X	X	X	X
17 Conduct Land Use Planning		X			X	X	X	X	X	X
18 Conduct Engineering Design	X	X	X	X	X	X	X	X	X	X
19 Conduct Drafting	X	X	X	X	X	X		X		
20 Conduct Title Searches										
21 Perform Tax/Fee Billing & Collect					X	X	X			
22 Create & Manage Mailing Lists					X	X	X			
23 Allocate Human Resources							X			X
24 Perform Facilities Management			X	X	X	X		X	X	
25 Perform Inventory Management	X	X	X	X	X	X	X	X	X	X
26 Perform Resource Management		X			X	X	X			X

Table 2 (continued)

POTENTIAL USES	DATA REQUIREMENTS																	
	BASEMAP	ENVIRONMENTAL OVERLAYS	ENGINEERING OVERLAYS	PLAN/PROFILE DRAWINGS	PARCEL MAPS	PARCEL/ADDRESS TABULAR DATA	AREA TABULAR DATA	STREET NETWORK FILE (GBF)	STREET TABULAR DATA	AREA BOUNDARY MAPS								
27 Conduct Weed Control																		
28 Perform Map Management	X	X	X		X	X	X			X								
29 Conduct Drawing Management			X	X	X			X	X									
30 Perform Data Base Management	X	X			X	X	X	X	X	X								
31 Conduct Development Tracking					X	X												
32 Disseminate Public Information					X	X	X			X								
33 Respond to Public Inquiries		X			X	X	X	X	X	X								

Table 2 (continued)

other applications).

These generalized categories of software procedures are representative of an expansive range of tabular and cartographic G.I.S. procedures available for data entry, analysis, manipulation, display and management.

Distinctions must be drawn between automated geographic information systems and computer aided design-type systems. An automated geographic information system is a computerized system composed of hardware, software and a data base, all of which are designed to efficiently store, analyse, display and present geographic data. Systems built around the interactive display technology of the interactive CRT (typically accompanied by hard copy devices, digitizers and so forth) are considered graphic systems, many of which can create, store and display map graphics. The emphasis of these systems is on relationships visible to the user, resulting in implicit understandings of the user about how data interrelate. This contrasts with the emphasis of G.I.S. systems upon data and topological relationships, which results in explicit data relations and data base concepts.

The procedural techniques which spring from the municipal data model require a relational data base management structure within a G.I.S., and a broad array of tabular and cartographic procedures. The array of G.I.S. software tools which are now available allow different data sets in mapped or tabular form to be correlated, interrelated and interpreted in a variety of ways. The G.I.S. geometric tools are particularly important for translating implicit relationships held on maps into explicit relationships which may be stored in tabular form for use in diverse ways in conjunction with cartographic elements. Some of the more important of these tools used to establish these explicit relationships include polygon overlay, point in polygon, line in polygon, buffer and network analyses. By incorporating relevant data into usable tables, various manipulations may be conducted mechanically, thereby eliminating time-consuming manual searches for data, manual interpretation and reporting efforts. For example, searches to identify the distance of a sewer line to a given parcel or the distances between fire hydrants and a land parcel which they serve may be queried instantly, with the findings automatically produced.

Appendix 1 provides a description of software procedures which would be typically invoked to operate on the generic model and support the tpical application functions common in a municipality.

Interpreting Interrelationships among Data Components

Historically, the principles of data base management have been applied to the development of a G.I.S. for a single-function application, such as the automation of tabular records on tax assessment. However, by conceiving of the entire municipal data model and each of its relevant interrelationships and uses, it is possible to apply data base management principles to the entirety of land-related municipal operations. A multi-purpose G.I.S. capable of responding to a broad range of municipal project needs in a systems orientation may be thus derived.

In examining the graphic representation of the data model (Figure 1), one

can see the interrelationships between these generic data types and how, by interrelating them, one can create new data or convert original data into another form.

1. Interrelations using topological overlay. Environmental data may be transferred to the parcel address tabular file. In this case, environmental polygons, lines or points may be overlaid on top of the parcel maps, and a topological overlay technique may then be used to calculate areas with certain soil or flood-prone characteristics based upon the environmental overlay. The new data may then be stored in the actual parcel tabular file. An example of an environmental overlay on top of a parcel map could involve the overlay of flood plains on parcel maps, with a product being the designation on the parcel/address tabular data base of those parcels which contain flood hazards.

   Another procedure involves the topological overlay of engineering maps on top of parcel maps to form tables of attributes by parcel concerning engineering data. For example, such a procedure could show the relationship of a sewer line in the street and a parcel that runs across the front of it, by tagging each parcel that has sewers. This would be accomplished by running the polygon overlay of the parcel map on top of the sewer infrastructure overlay.

2. Interrelations using graphic overlay. The graphic overlay function can be used to overlay engineering indexes or engineering drawing data on top of parcel maps (i.e., to show the graphic relationship of utility overlays to specific parcels). The base map with contours and control can be used as a basic underlay for the composite of engineering and environmental or parcel maps within the municipality. This type of graphic function, although visually of value, is not a topological overlay as described previously in which maps are intersected and joined to create actual extensions of the tabular files.

3. Interrelations using address geocoding. By taking the address tabular data base and the address geocoding software, one can associate address tabular data to the street network file, thereby creating a street tabular data base. For example, by associating police statistics collected by street address to the street network, tabular data by street face regarding crime may be created.

4. Interrelations using polygonization. The street network file (geographic base file) may be converted into polygon boundaries by employing polygonization techniques. Specific software is available which may be used to polygonize the various street links into polygon

boundaries.

5. Interrelations using relational matching. The relational matching procedure is another technique commonly used to relate various data entities for functional purposes. It is commonly used to relate parcel maps with parcel address tabular data, parcel tabular data with area or street network tabular data bases, network map with network tabular data bases, and area map with area tabular data bases.

Data Interrelationships outside the Municipal Model

Beyond the basic model, a typical municipality has other kinds of data base linkages which should be recognized. For example, in the Province of Ontario, the base map, environmental data and a large volume of parcel data are provided by provincial agencies, much of the area tabular data is provided by Statistics Canada, and tabular data about street faces is provided by various transportation agencies also outside the municipal realm. In other words, there may be important relationships between the municipality and various outside organizations which are vital for the information they provide into the basic data model. In the U.S., the U.S. Census Bureau may provide area tabular data to municipalities, for example. Yet, sometimes related base maps are provided by the municipalities themselves, which in turn rely upon control by an outside organization with geodetic monumentation. These types of data interrelationships must be carefully considered and understood in applying the principles of the conceptual model.

Findings and Implications of the Conceptual Model

The municipal data model described in this paper has broad applicability for other cities of varying sizes and configurations. The essential concepts discussed here should be relevant to a range of user situations and applications. What is important is the specification of essential data elements, user functions, and the tool-box of software procedures which are fundamental for fulfilling the requirements of the urban municipality today. It is important to recognize that software packages are currently available to support the data model which has been described.

There are several basic implications of the municipal data model. Firstly, it provides a description and illustration of the basic municipal data types and their relations. Using this information, a system designer can better understand how these components interrelate and thereby design linkages which accurately account for data dependencies and independencies. Lacking such an understanding, the designer is likely to reiterate basic flaws and problems which have affected municipal data inventory design in the past.

This model should also be useful as a base for designing application procedures which respond to user needs. It is felt that this model provides a basic and meaningful context for the development of application

software to be used in particular departments or applications. In addition to these two basic uses, the model has value for a data base administrator, for whom the model shows the relationships between individual data entities that must be solidified in order to have optimal interrelations of the data base.

It is important to note that a variety of single purpose functions are typically carried out using the same or similar data within a given municipality. When these commonalities are identified, and a broad-based set of data entities are established, redundancies of data and user function may be reduced or eliminated.

This model may also aid a non-municipal agency to better understand the data model, and ways in which such an agency may provide data to a municipality in a format which relates to the currently operational data bases within the municipal environment. For example, using the model, a survey organization can determine the best formats and geocodes in which to deliver data products which may become part of a municipal data base. In other words, the data model is intended to present a common vernacular which helps in communication regarding ways in which a particular data item being collected fits into the municipal model. The models also show the way in which information flows from very specific data which is collected (i.e., address information about a parcel) to more generalized summaries of data (i.e., tabular data summarized to the street face or to a specific aerial unit).

To integrate this conceptual model in an actual functional model, several steps are required. First, a detailed description of the data items which exist within each of the general data classes must be developed. In getting clear on this specification, it is necessary to identify for each data item the agencies from which the data originates, is updated and is utilized. Then, the linkages or interrelationships between these various data items and entities may be understood, as well as the ways in which various municipal transactions affect particular data in the system. Using this information as a base, the design of an efficient and sensible automated data system may proceed.

Appendix 1

GENERIC DEFINITIONS

GEOGRAPHIC DATA MANAGEMENT PROCEDURES

A. TABULAR DATA PROCEDURES

1. **Compilation** - is the conversion of image and tabular data into spatially related component information. This procedure can be done manually or by machine, and may be supplemented by field work or other collected information.

2. **Data Entry** - is a process of key entering tabular data into a structured file. This is typically accomplished by using a CRT terminal with a formatted screen.

3. **Update** - is a process of revising stored tabular data on an automated system. This is best performed using an alphanumeric screen editor with well-defined software procedures to control the process.

4. **File Management** - is the orderly storage, management and retrieval of tabular data. It involves storing a sequence of records or files in an efficient structure for space management, indexing capability, and means for easy access, manipulation and restoration of the records or files to their original file location. This procedure may also involve an archival process for the storage and retrieval of data on magnetic tapes, including backup files.

5. **Data Manipulation** - includes the abilities to perform various arithmetic and logical operations on tabular data, as well as to sort and relate different data sets to each other. This is normally done within the context of a model, process or procedure. There are three levels of data manipulation: the file level, the record level, and the algorithmic level. The processing is concerned with the operations of a set of entities within a file. Record processing is concerned with the retrieval of specific records from a file and the subsequent manipulation of fields within the record using arithmetic or logical functions. At the algorithmic level, procedures are used to manipulate individual values for a particular purpose.

6. **Statistical Analysis** - is concerned with the aggregation of data according to well-defined statistical procedures in order to provide the user with a better perspective on

the collection of data. The parameters prescribed regarding data collection itself are very meaningful for interpreting the data in the aggregate rather than individual data items. Statistical analysis includes a number of clearly defined functions such as standard deviation, mean, average, regression, correlation, factor analysis, principal component analysis, etc. In each of these examples, the data is viewed as a collection rather than as individual entities. Statistical analysis is usually defined in terms of a library of functions. It is important to understand what is being done by the functions in order to be able to properly interpret the results of the analyses.

7. On-line Query - is the process by which one selects items of interest according to certain criteria. The criteria are normally based on arithmetic and Boolean connectives. This process typically results in a list of data items which can be displayed by a report generator or stored in another file to be operated on by other functions. The output is a set of items which satisfy the condition or conditions specified.

8. Report Generation - is a mechanism by which information is identified, extracted, ordered and displayed in tabular form, based upon access from a single file or a set of files. The user specifies output formats on the file or files. A user may also define operations to be performed on the data items such as summarization, averages or any logical operations in a standard form.

B. CARTOGRAPHIC DATA GENERATION

9. Compilation - is the conversion of both image and tabular data into spatially related information, typically as plotted on a map. It can be done manually or by a machine such as in stereo compilation from aerial photographs or topographic mapping. It may be supplemented with field work and existing collated maps, as well as with data retrieved from tabular reports. The process include the compilation of horizontal control and geometric data by COGO.

10. Digitizing and Edit - is the digital encoding of compiled map data including points, lines and polygons. Editing of digitized data is simply the elimination of errors created during digitizing, the replacement or displacement of line segments and so forth to the proper position. Such errors are generally cartographic in nature.

11. COGO (Co-ordinate Geometry) - is a set of mathematical tools and functions for encoding and converting bearings,

distances, angles, and so forth into co-ordinate information. This operation is normally done on an alphanumeric screen into which data is entered and the geometry is determined analytically.

12. **Update** - is the capability which permits the revision or addition of information to reflect changes that have taken place in the data since compilation was last performed.

13. **Map Join/Edge Match** - is the process of removing inconsistencies at the edges of maps from compiled map data so that the features match across map sheets. Edge match, map join and merge all constitute one function. Edge match can be considered a tie, map join is putting them together, and merge implies a global joining of a group of maps. Map joining compiles the physical and logical joining of map entities (features) from one map sheet to the adjacent sheet. While features may not be physically connected, they are logically connected. For example, a utility crossing several map sheets may not physically connect to itself at map edges, but its segments will be logically connected through pointers in a digital file. In a manual system, map joining simply requires ensuring that lines and features match at sheet edges where map sheet join. Map sheets, however, may also be physically connected as in the continuous map.

14. **Address Geocoding** - is the process of assigning alpha-numeric locational identifiers (such as the municipal address or a physical location) to spatially related information. For example, an address may be matched to an address range on a street segment, or a given spatial area, i.e., the limits of a polygon, a line segment, a point along the segment, or an absolute point that has been co-ordinated. The process implies a geographic base file which can be used to pass addresses by in order to find out characteristics about the geometry. This capability allows addresses to be matched to:

    (i) a specific point between street intersections;

    (ii) a complete line segment such as the street plan of a block, census tract, school district or other unit.

    Geocoding can also be considered the encoding of something that can be related to position. It may involve matching an address to a place on the earth's surface, such as a specific property, a street face or block to a census tract or any other polygon. It may also involve digitizing of points, lines and polygons or

legal descriptions and defining their location by x, y co-ordinates.

15. Storage Management - is the orderly storage, management and retrieval of cartographic data. It supports point, line and polygon data in a format providing for efficient access, manipulation and retrieval.

C. CARTOGRAPHIC DATA GEOMETRIC ANALYSIS PROCEDURES

16. Polygon Overlay - is a function which allows the processing of one or more sets of polygons which have been overlaid to form a combined set of polygons. This results in a common set of values for the sets involved. There are different combinations of polygon overlays. One is used in update where it only takes on the attributes of one of the previous sets, and is a process for cartographic analysis. Polygon overlay can be broken down into several other techniques such as line intersection, point in polygon, and cellular overlay. These are all techniques used to carry out the polygon overlay function.

17. Vector Cell/Cell to Vector Conversion - is a process for the conversion of x, y co-ordinate data expressed as vectors, points, lines and polygons into a cellular structure and also the conversion of cellular data into an x, y co-ordinate format. The grid cell is a tile of an arbitrary two-dimensional ruling of the surface of the earth. The vector conversion requires the transferral of cartographic files from an x, y co-ordinate form to a cellular form. Cells can be of any size, orientation or shape.

18. Polygon Dissolve - is the capability to merge two or more polygons which share common attributes by eliminating the shared boundaries.

19. Point in Polygon - is the procedure which determines if certain points lie within a given polygon. This capability can be enhanced so that the attributes of the polygon are assigned to points that fall within it.

20. Transformations - are mathematical expressions used to convert co-ordinate data within one frame of reference to co-ordinate data in another frame of reference. It is used for a variety of applications including changing from one map projection to another map projection, or converting from one set of co-ordinates captured on a digitizer to UTM ground co-ordinates.

21. Buffering or Corridoring - is a process whereby a polygon or zone of fixed size is created around a point, line or

polygon. These polygons are sometimes created based on the attributes of given cartographic features.

22. **Windowing** - is a function allowing the user to define a specific geographic area which is used to delimit a piece of a map or cartographic area. This process involves maintaining the attributes with the cartographic features. The cartographic features and the associated attributes can be retrieved using a window for subsequent display, analysis and manipulation.

23. **Co-ordinate Filtering** - is the process of weeding out superfluous co-ordinates. It is used to generalize maps and to reduce requirements for computer storage.

24. **Proximal Analysis** - is a procedure which involves the creation of polygons or areas around randomly spaced point locations. It is carried out by dividing equally the distance between paired points, then generating perpendicular lines to these midway points which are then extended to intersect and form areas. This process is used for creating polygons, mapping, and analysing qualitative data where continuous coverage map is desired, but where contouring is not appropriate. It is possible to obain pictorial displays of discontinuous data using this method.

25. **Line Length Calculation** - is a procedure for computing the distance between successive co-ordinate pairs forming a straight line or following an irregular path.

26. **Area/Perimeter Calculation** - is a procedure for geometrically computing the area or perimeter of polygon features.

27. **Spatial Aggregation/Districting** - is a procedure which allows the user to semi-automatically determine districts. It provides the capability to aggregate polygonal data into larger units of polygonal data. Polygon dissolve is used as an operation of polygon aggregation. Districting is the process whereby areas may be interactively aggregated by utilizing topological boundary information around a set of entities, (i.e., the ability to spatially aggregate polygons into larger polygons including the aggregation of the attributes by using t[illegible]logical identification of boundary nodes and segments, or by using a graphic function such as polygon overlay.)

28. **Distance Accumulation** - is the process of aggregating spatially distributed data within a specificed distance from a feature. This procedure is used to summarize or enumerate geographic features such as points, lines or polygons and their attributes within a user specified

distance of a particular geographic location. This is typically done using a grid cell-by-grid cell summarization with user specified distances.

29. Contiquity Analysis - is concerned with adjacency relationships between any given polygon and its neighbours. Typically, this involves summarizing and relating the attributes of neighbouring polygons to the polygon being examined.

D. CARTOGRAPHIC DATA NETWORK ANALYSIS PROCEDURES

30. Optimal Path Selection - is the process of using a network data base of road and road intersections to select the optimal path based on specified time/distance relationships.

31. Flow Simulation - is the ability to dynamically simulate movement of a collection of entities through a network. The technique is typically used to simulate vehicle flow on a street, pedestrian movement through a pedestrian network, water moving through a pipe network, electricity moving through a concrete network, and so forth.

32. Time/Distance Districting - is the ability to measure time/distance and accumulate time/distance data through a network radiating out from a given point, and associating these time/distance values to the points through which the measurements are taken. This procedure is used to define contour distances away from known points, and to determine districts which are created from a variety of such processes. It may be considered as proximal mapping on a network time/proximity/districting rather than distance bases.

E. CARTOGRAPHIC DATA DIGITAL TERRAIN MODELLING PROCEDURES

33. Spatial Interpolation - is the capability to interpret proportions beween points of known elevation for the purposes of establishing contours or elevation values between these points. This is typically done using random point data, which is interpolated into a grid or triangulated surface or facets.

34. Contouring - is the capability to derive lines of constant elevation or given values of elevation by photogrammetric means using interpretive techniques or by vertical survey traverses. It may be used to fit a line through a series of randomly distributed or regularly distributed points of known elevation.

35. Slope Aspect - is the capability to calculate the

topographic slope for each aspect of a given area. The term slope addresses the steepness of an area, while aspect relates to the direction in which an area is oriented. The average slope has eight surrounding neighbours, and there are six different ways to calculate slope on a regular elevation basis. The calculation of the angle of the topographic slope is generally based on a digital frame file with its grid of polygons and the classification of that surface of slope variation into slope ranges each is certified by five to ten, ten to fifteen, etc. The calculation of topographic slope can be displayed with colour or shading. The calculation of the direction of those slopes is broken into facets, e.g., North, North East, North West, etc.

36. Sun Intensity - is the calculation of the potential sun intensity measured in British thermal units based on the angle of slope, direction of slope, and location of the sun relative to that slope. This is based on sun estimates and angles based on time of year and hour of day, and comprises the angle of incidence of the sun with the surface of a particular time.

37. Viewshed - is the capability of calculating and displaying the land site across the top of reference surface for one or more selected view points.

38. Watershed Analysis - is the calculation of the topographic peaks, pits, course lines and watershed boundaries on topographic surfaces. It produces an aspect map with conductivity, and calculates ridge and course lines.

39. Volume Calculation - is a computation of volume based upon the overlay of two surfaces of topographic data distance between them. This is achieved by subtracting one surface from the other.

40. Cross-Sectioning - gives the capability to extract a 2-D profile from a 3-D surface, allowing any user-defined path to be produced.

41. 3-D Viewing - provides the ability to display a topographic surface by producing a 3-D graphic. A 3-D representation of a digital terrain model is created in the procedure.

F. CARTOGRAPHIC DATA QUERY PROCEDURES

42. Spatial Query - Allows the extraction of cartographic data based on user-defined windows, such as a circle, or other regular and irregular shapes.

43. **Attribute Query** - offers the ability to select data items from a file system based on the values of specific attributes or combinations thereof, defined by arithmetic, relational and logical expressions.

G. CARTOGRAPHIC DATA DISPLAY/COMPOSITION PROCEDURES

44. **Query/Window** - defines the logical partition or bounds of the data base which determine the range of a query.

45. **Generalization** - is the process of weighing co-ordinates and unnecessary data, such as in the deletion of polygons based on mineral size, elimination of other minerals, and so forth. This process concerns maintaining information content consistent with the skill with which it is being represented.

46. **Scale Change** - provides the ability to plot or display data at a user-defined scale. With this capability, scale is not confined to the input scale. This procedure may involve generalization techniques.

47. **Cosmetic Enhancement** - offers the capability of adding text and cartographic symbology, by automatic or manual means, to improve the presentation of a graphic product. This includes legends, names, surround material, etc.

48. **Graphic Superimposition** - is the integration of two or more graphics in a consistent manner over the same area.

H. CARTOGRAPHIC DATA DISPLAY/PRESENTATION PRODCEDURES

49. **Polygon Mapping** - is a cartographic display of regularly or irregularly shaped polygons and their attributes. Typically, this capability includes shading, symbology and numeric labelling, as well as a variety of other map cosmetic functions for generating alphanumeric labelling of polygons.

50. **Point Mapping** - is the depiction of attributes with graphic symbols or alphanumeric values as per user specifications.

51. **Line Mapping** - provides cartographic display of linear features by means of x, y co-ordinate pairs.

52. **Surface Mapping** - is the display of three-dimensional information in terms of 2-D or 3-D forms. This can be achieved through contour mapping of 3-D relief displays, or colour, shading, hatchering or other techniques.

53. Annotation/Text - is the positioning of actual textual data including graphical symbology for place names, feature names, surrounding data, etc.

I. IMAGE DATA PROCEDURES

54. Geographic Image Management - involves the procurement, filing, distribution, retrieval and archiving of analogue or digital spatial information such as aerial photographs, satellite images, line maps, photos, video discs, etc.

55. Data Collection - is the process of assembling image information about a single entity or collection of entities.

56. Image Data Storage - is the orderly retention and management of image data. Space management, indexing capabilities, and ease of access, manipulation and restoration after use are typically undertaken as aspects of image data storage.

57. Image Data Retrieval - involves locating and providing on demand information associated with a given data item.

J. TEXT DATA PROCEDURES

58. Text Management - involves the collection, storage and retrieval of unstructured textual information pertinent to the geographical information. This is used, e.g., to maintain geological data, descriptions of historic sites, text associated with horizontal control stations, and so forth.

59. Entry/Edit - is the process for entering text data into structured file format.

60. Collection - is the process of assembling textual data from various sources for use in relation to a particular project or analysis.

61. Text Data Storage - involves the orderly retention and management of text data.

62. Text Data Retrieval - involves locating and providing on demand textual information.

K. BUSINESS GRAPHICS PROCEDURES

63. Business Graphics - involves the creation of forms or tabular data that will be displayed in a graphical format

such as pie charts, graphs, bar charts, line graphs, etc. for the purpose of displaying information usually associated with statistical analysis.

64. Analysis - analytical assessment of data, activities, associations, etc.

65. Display - is simply the depiction of a cartographic map, graph or drawing on some kind of display device. It is the resulting product of a cartographic composition, and a final presentation of a graphic manuscript. It could be a finally drafted product displayed on a screen or put on an automatic plotting device.

L. BIBLIOGRAPHIC DATA PROCEDURES

66. Indexing - involves the creation of topological structures to facilitate access to large collections of data entities (records).

67. Storage - the process of maintaining information over time.

68. Retrieval - the ability to locate and provide on demand the information associated with a data item.

69. Data Catalogue - includes procedures for the indexing, storage and retrieval of bibliographic data.

PROPOSED CONCEPTUAL AND FUNCTIONAL MODELS FOR PROVINCIAL DIGITAL TOPOGRAPHIC DATA BASE

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Abstract

The need to share land-related data between a variety of users both within municipal and provincial agencies, has led to the creation of a number of specific data base models. A conceptual model identifies the various provincial land-related data bases and their relationships to each other, while a functional model attempts to define how the system environment operates with respect to realizing data base needs. It is expected that the models will provide a framework for implementing shared land-related data base environments for general users of land-related data.

Introduction

In carrying out the municipal information needs study, it was deemed appropriate to interview the various provincial agencies which deal with land-related information, especially where the information was of value and of potential use to municipalities. The interest in a provincial georeferencing perspective dates back to the origial georeferencing mandate undertaken by the Ministry of Natural Resources in 1974 and 1975. In the intervening years a number of developments have been pursued ranging from the creation of a base map series, namely, the OBM 1:10 000, 1:20 000 and in municipalities 1:2 000. A number of pilot projects were also undertaken to establish the viability of maintaining much of this data in digital format. At the same time, many agencies have gone ahead to develop systems in which there is a land-related component.

The present study is an attempt to create a conceptual framework which would permit co-ordination of land-related data bases within the Province of Ontario.

From the study a number of relevant observations pertinent to georeferencing can be summarized as follows:

1. There is a large number of existing data base systems in place within provincial agencies, each with a reasonable degree of sophistication. These data bases had been developed, primarily, to service the appropriate mandate areas. In many of the systems studied, there are land-related components, although the overall perspective of the data base is not usually that of a land-related information system. Specifically, the systems have been

designed to handle the data requirements of specific agencies. In carrying out this function it is often necessary to maintain land-related data items, although there is limited capability for geographical information processing per se.

2. It was obvious that there are many unco-ordinated georeferencing activities within the province. Most of these make use of georeferencing facilities, including maps. The most common maps in use were those of the National Topographic Series (provided by the Surveys and Mapping Branch of the Department of Energy, Mines and Resources in Ottawa), as well as OBM (Ontario Base Maps) and FRI (Forest Resource Inventory) maps of MNR. The NTS maps are used in cases where the data is shared in common with federal agencies, for example, Geological Survey, etc. The OBM map does not provide comprehensive coverage of Ontario at this time and therefore is not yet widely used. There is, however, increasing use of the OBM map but it is still far from being the common base map for many applications. In many of the northern municipalities, the FRI base map has become a standard, simply because of its availability.

3. A number of special purpose geocodes have been developed by individual agencies in order to meet their own short term needs. These geocodes tend to be specific to a given ministry or agency. These codes are structured so that they can easily be incorporated into a comprehensive geocoding scheme for the province. Of specific interest is a geocode structure used by the Ontario Geological Survey. A set of GAP (Geographical, Administrative and Planning) maps were developed to correlate information between different spatial entities found in Ontario, namely, township names, MNR regions and districts, MNR planning boundaries, mining divisions and areas and municipal boundaries.

4. There is some limited activity in terms of geographical information processing currently in place within provincial mandate areas. Of particular interest is the forest resource inventory system, as well as the plans currently in place for the development of a G.I.S. capability for the Ontario Geological Survey.

General Observations of Provincial Environment

During the user needs study a number of important facts emerged as general observations. These include the following:

1. There is a considerable interest in georeferencing and the logical integration of data with external data bases. Many agencies work with land-related information and are very interested in gaining access to other complementary

information which would assist them in carrying out their own mandates. Often, access to this information is achieved through unnecessary duplication of effort, either in the transfer of information or in encoding of existing graphics by digitizing.

2. There is a need for a digital topographic data base which would provide access to land-related information in a common format. This perceived need could only be firmly established when there is sufficient digital information to permit users to gain a better understanding of the capabilities of such a data base.

3. There is a need for an effective data interchange mechanism which will permit agencies to share information of common interest between each other. Most of the attempts for data interchange have been developed through personal contacts between agencies.

4. Many of the G.I.S. functions which are sought by various users could be provided through the development of common support libraries. Essentially, there is a commonality of function which could be shared amongst the community of users.

5. There is a great potential for the use of a digital topographic data base for on-line applications. At present, a number of agencies are working at least in an experimental capacity with digital topographic data; specifically, OMAF, FRI, OPP, OGS, etc. It is necessary to facilitate the access to such information and to assist potential users in the creation of common resources for georeferencing purposes.

Provincial Recommendations

Based on the information available from the study, specifically, with respect to provincial agencies, a number of general recommendations were arrived at. These are as follows:

1. There is a need to establish a provincial parcel definition data base. The evidence to support this recommendation is based on the observation that parcel definitions are used by a variety of ministries and agencies. There is also a need for parcel definition within the municipalities as identified by the municipal information needs study and referenced in the municipal conceptual and functional models. Of particular concern is the number of agencies who are currently involved with some aspect of parcel definition. These include the OASYS System of the Ministry of Revenue, the POLARIS System of MCCR, the Lands and Waters Group of the Ministry of Natural Resources, as well as the various municipalities who currently maintain their own parcel definitions.

   Some of the concern about maintaining a single definition

data base is based on the need to provide comprehensive updating facilities. At present, each agency which has an interest in parcel definition maintains its own information items. Where the information items overlap it is the responsibility of each agency to locate the appropriate changes to the information and consequently update their own information base. This task would clearly be facilitated if there were a single parcel definition data base common throughout the province.

There is also considerable interest in a single parcel definition data base in order to facilitate access by a number of application areas including OMAF, FRI, etc.

The parcel is the major data element in building interdependencies between land-related information entities and as such is of potential interest to many users of land-related information.

2. It is proposed that "position" be the primary key for land-related data bases, specifically, within a digital OBM data base framework. The evidence for such a conclusion is based on the existing general use of maps for most applications dealing with land-related information. As well, a variety of geocodes have been developed which rely on position as their major component.

3. A variety of data base resolutions are required. It is obvious that no single data base will provide the comprehensive coverage required for all agencies and application areas. The data resolution needs vary from agency to agency. For example, within MTC, the emphasis is on large scale engineering design applications. For POLARIS, the emphasis is on high-accuracy ownership information for parcel data. In like manner, the OASYS system is concerned with the storage and management of attribute information. A number of spatial attributes are also important and are required for analysis by various application areas and for which accuracy and quality are primary concerns.

4. It is recommended that a digital OBM data base be created. The evidence for this conclusion is based on the need to establish a common reference base for positionally related information. Since the OBM map is designed to provide this base, it is necessary that this be in digital format in order to promote the use of a variety of digital applications. It is anticipated that this will become of increased importance for a large number of applications as identified in the interviews. There is also a need to enhance the technical capability of the photogrammetric and survey industry by promoting and assisting in the deployment of digital technology. This technology provides a new base for exploiting technological innovations which are arising throughout all aspects of the industry. Lastly, it is seen that there is a need to evaluate

the potential as well as the cost/benefit of a digital OBM mapping capability.

5. It is recommended that a common system perspective be developed for managing and using G.I.S. data within the Ontario government by:

1) **Creation of a Common Software Function Library**

This would greatly assist a number of new users as well as providing a common functional capability for all users within the provincial perspective in using land-related data.

2) **Establishing a Digital Data Interchange Facility**

In order to have a comprehensive land-related data base perspective within the province, it is necessary to have means of being able to readily interchange data between interested parties. Initial attempts in this area have been made by the Specification of the National Topographic Classification Standards for digital OBM data files. This standard has yet to be proven, however, it does recognize the need for common data interchange standards. This standard is somewhat limited in that it emphasizes topographic data with little emphasis on the land-related applications or thematics. As well, it does not, at this time, address the needs of data structure or topology which are crucial for some applications (e.g., municipal parcel fabric).

3) **Promoting Special Data Base Structures and Specifications**

The ability to manage and manipulate spatial information is predicated on having access to the appropriate data structuring tools and capabilities. This is particularly important for maintaining topology within parcel structures as well as other network applications such as street networks, drainage systems, etc. Availability of common topological structures such as parcel data base management systems would greatly facilitate the use of this information by associated user agencies.

4) **Providing Common Data Sets (e.g., Ontario Base Maps)**

There is clearly a need to provide a number of data sets which are of common interest to the community of potential users. Of particular interest would be the Ontario Base Map as well as the township fabric, Linear Highway Referencing System of MTC, etc.

5) **Maintaining Common Data Dictionary and Data Directory**

If a data base is to function properly, it is necessary that there be a common understanding about the terms within the data base environment. The National Digital Topographic Standards provide an initial classification which can be extended to incorporate the needs of the thematic applications. There is also a need for a data directory to identify where the various data associated with land-related information are available to interested users. The data dictionary and the data directory should be universally accessible.

6) **Validating Provincial Model with Private Projects**

It is clear that it is necessary to have some form of prototyping and pilot project capability which will demonstrate and validate the concepts being promoted for a common system perspective. The pilot projects can provide a reference framework for potential application areas as well as assist those users who do not have the resources to undertake their own development work.

7) **Developing Provincial and Municipal Interfaces for Bi-directional Data Interchange**

A basic outcome of the municipal user needs study was the notion that considerable information is of mutual interest to both the provincial and municipal agencies. At present, this interface is ill-defined and has often been uni-directional. Any attempts to facilitate the interchange of data between provincial and municipal sectors would eliminate considerable redundancy as well as provide timely information to other interested parties.

8) **Developing a Federal/Provincial Interface for Bi-directional Data Interchange**

In the same way that there are links between the province and the municipality, there are corresponding links between the province and federal agencies. Of particular interest is the interchange of data for both basic topographic mapping and as well for resource applications.

9) **Developing a G.I.S. Information Centre for Consulting, Training, Technology and Tools**

It is clear that the G.I.S. area is one which requires considerable expenditures of time, energy, and resources

in order to properly utilize this technology. The deployment of this technology would be most readily facilitated by providing a common information centre. It would assist the potential users in meeting their G.I.S. requirements. The concept of an information centre has been effectively exploited for the data processing industry in particular, and could well be applied for specific application areas such as geographic information systems. It would be necessary that the centre be staffed with experts who could provide expertise to users as required.

10) **Encouraging Private Sector Component with Digital Capability**

Perhaps the greatest incentive to encourage a common digital system perspective would be the creation of a strong digital capability within the photogrammetric and survey industry.

11) **Creating Data Base Environment for Sharing Common Spatial Data**

A common system perspective is best created by encouraging a data base perspective for sharing land-related information. This does not imply a single hierarchical data base but rather an environment in which data is readily shared between different mandate areas. The data base environment emphasizes both data as well as the functions which can be executed or effected on the data.

12) **Establishing a Georeferencing Data Base Co-ordinating Committee**

It is clear that the G.I.S. technology is still in its infancy and considerable developments are yet to take place. In order to encourage a common system perspective, it would be desirable to have a co-ordinating committee to assist in the deployment and dissemination of the appropriate common information base.

PROVINCIAL CONCEPTUAL MODEL

Introduction

The provincial conceptual model identifies various data bases with a land-related component which are within the provincial domain. In almost all cases, the data bases reflect the existing administrative stucture of ministeries and departments, each with its own mandate area. Invariably,

these data bases have been structured to manage and manipulate data appropriate for handling their own needs with at least one attribute having a positional land-related aspect.

Structure and Organization of the Provincial Conceptual Model

The proposed provincial conceptual model is designed to identify the land-related data bases and their interrelationships. This is shown schematically in Figure 1. The model is drawn to show dependencies left to right and top to bottom. For example, the POLARIS data base derives inputs from both OBM and MTC data bases and provides information for the creation of a proposed parcel definition data base.

The provincial conceptual model is seen to comprise a taxonomy of data bases including geodetic, topographic, parcel and resource data bases.

The various data bases which comprise a provincial land-related data base are described as follows:

Ontario Base Map Geographic Data Base

In most cases the land-related data for the various data bases are derived from any of a number of map sources including NTS (National Topographic Series), OBM (Ontario Base Maps), FRI (Forest Resource Inventory) base maps, etc. If the data is required in digital format, it is necessary to have some form of digitizing or encoding of the graphical map. This is often done locally and in this sense there is some data redundancy.

The OBM map provides a base for a variety of land-related data. At present, the information is available only in graphical format, although there is a move towards providing the planimetric data in digital format in an experimental capacity.

Parcel Definition Data Base

It is proposed to develop a provincial parcel data base which can be used to complement the topographic data base by providing a parcel fabric for the province. This data base would maintain the topological structures necessary for supporting a polygon based system. The primary input into this data base would be land ownership and cadastral information from the POLARIS data base, and assessment data from the OASYS system of the Ministry of Revenue. The parcel definition data relates to OBM directly through POLARIS.

Other Data Bases

The OBM topographic data base along with the parcel definition data base provides a conceptual framework for referencing land-related data from a

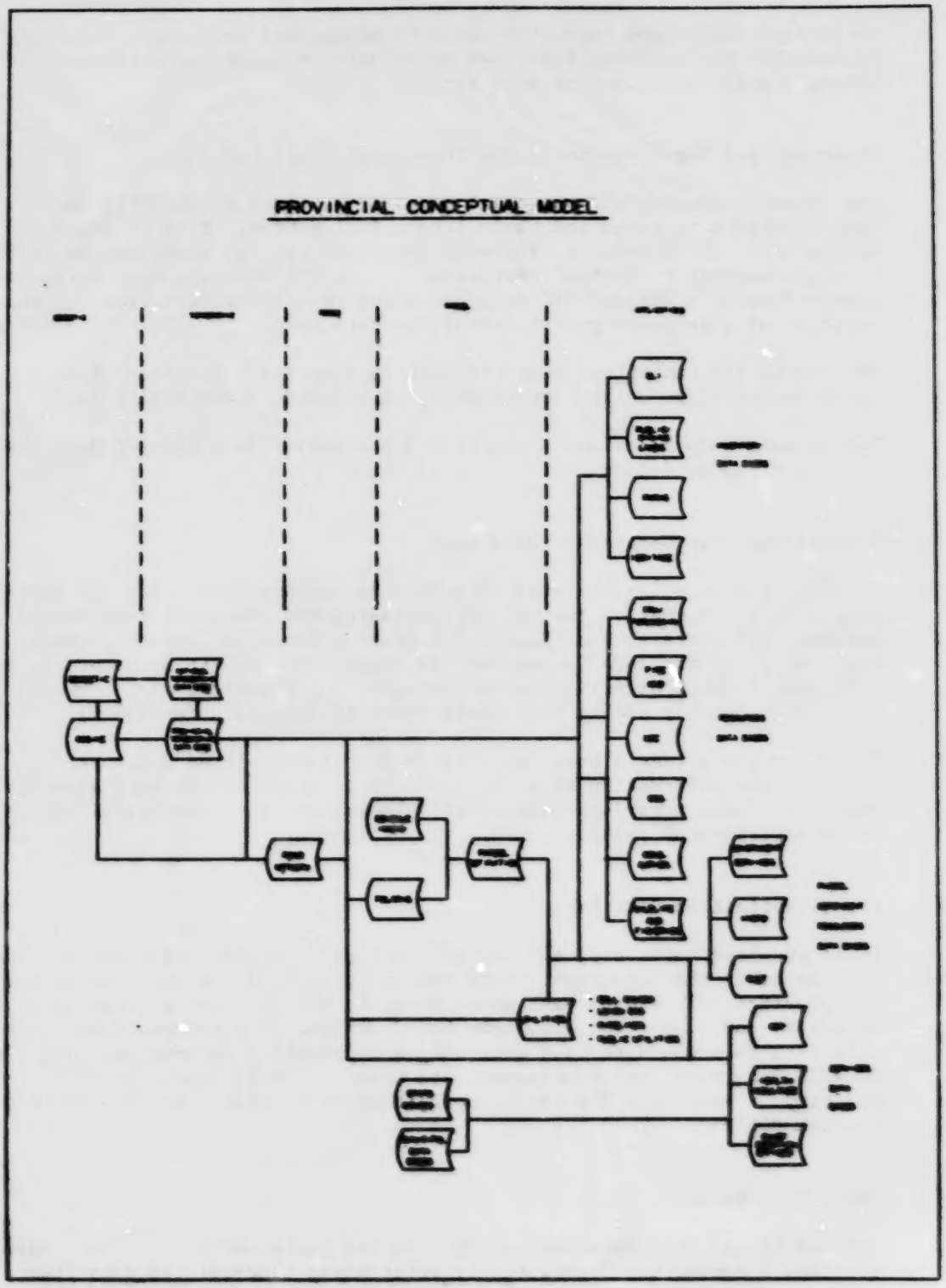

Figure 1

variety of other data bases. For purposes of understanding these data bases, they can be grouped into four major classes as follows:

1. Inventory Data Bases

There are a number of data bases whose primary responsibility is to maintain various forms of inventory. These include OLI (Ontario Land Inventory), Mining Lands, Parks, Heritage Data, etc. There are some limited functions associated with these data bases, however, invariably all associated processing is now done by conventional manual means. Some of the data is in graphics format (e.g., OLI) and hence can be used in conjunction with other graphical data by a user for specific decision making. In other cases such as Parks, considerable information exists in the form of user survey data which can be formatted for specific purposes and again used in a planning capacity. Other data bases such as Mining Lands and Heritage Data provide comprehensive inventories of data for rapid access and retrieval. The primary function on these data bases is simple access and retrieval of spatial data.

2. Resource Data Bases

There are a variety of data bases which maintain substantial land-related information and have an extensive functional capability associated with them. Since these data bases are usually associated with resource management data, their use reflects the function which is built into each data base. These data bases include FRI, Environment, OGS (Ontario Geological Survey), and the Conservation Areas, etc.

The resource data bases rely on access to a good topographic base on which various thematic data can be superimposed. This information is both spatial and attribute based and hence requires sophisticated data processing techniques for its proper management.

3. Parcel Oriented Resource Data Bases

A particular class of resource data bases relies extensively on a parcel definition for its proper functioning. These data bases, including Hydro, MNR (Natural Resources), OMAF (Agriculture and Food), Government Services, etc. rely to a degree on the spatial framework provided by OBM, while maintaining a primary interest in the characteristics of the parcel fabric.

4. Service Data Bases

A number of data bases have need of the basic street and parcel fabric with respect to a positional base provided by OBM. Such data bases as OPP (Ontario Provincial Police), OASIS (Ontario Ambulance Service Information System) and the

Chief Election Officer currently obtain this data from a variety of sources including maps, formatted data files, records, etc. The primary information provided by such service data bases includes accurate position with respect to street and parcel fabric as well as access to supplementary information available from external files (e.g., Statistics Canada for demographic data) as well as municipal records, etc. The role of such service data bases is likely to increase with an increased emphasis on social services.

External Data Bases

There are a number of external data bases which logically relate to the total provincial data base environment. These include a variety of utility company data bases such as Bell Canada, electric distribution, gas, pipelines, etc. Most of these data bases relate to the OBM and Road Network data bases.

PROVINCIAL FUNCTIONAL MODEL

Introduction

The provincial functional model is based on the inherent explicit structure of the existing provincial land-related data bases. As identified in the conceptual model, each data base operates autonomously and reflects the function of the associated mandate area. Since each data base is essentially self-contained, there is no attempt at providing any form of data base integration, with the result that there may be many instances of data redundancy. In like manner, few if any real data base issues (such as integrity, consistency, access control, etc.), are being fully addressed.

The primary mechanism for data transfer between data bases is likely to be formatted data files via magnetic tape. These files may reflect specific standard formats (e.g., OBM planimetric data files in SIF format) or may be designed to accommodate the needs or capabilities of either the user or the recipient.

Operation of the Provincial Functional Model

The provincial functional model is based on the local data base processing environment of each prospective user. In order to facilitate the handling of land-related data, it is necessary to augment the existing capabilities with an appropriate set of data base and geographical data handling tools.

A primary requirement is an ability to reformat data from an external file to formats consistent with the local data system. To achieve this, a translation system is envisaged which would permit user specification of both formats with the necessary translation rules. Since the transfer

medium is a sequential device, minimal topological information can be communicated except by the use of internally defined tables. In this way, topology must be communicated by tables which are implicit in the data structures of the associated file systems.

Access to Topographic Data Files

The digital topographic data files are structured as formatted files as defined in the "Digital Specification For OBM Topographic Files". This file contains the planimetric data associated with a given map sheet. In order to meaningfully process this file, it is necessary to have access to a data dictionary which provides the feature codes for all data encoded within the file.

Since the topographic file is a sequential file, it may be desirable to reformat this file on a random access device for random access processing purposes. This would require the creation of feature directories during the transfer and maintenance of the following data structures:

1. Polygon data structures can be maintained (for parcel definitions, thematic polygons, etc.) in terms of the following structured data constructs:

   a) polygon table with each entry showing the following minimal data:

      i) polygon identifier;
      ii) number of segments in polygon;
      iii) ordered segment list of boundaries.

   b) segment table with each entry showing the following minimal data:

      i) segment identifier;
      ii) end points of segments;
      iii) number of points in segment;
      iv) pointer to position data record;
      v) adjacent polygon identifiers.

   c) position file which is a file of logical records, each of which records the ordered sequence of points making up the segment.

      In many cases, attribute data will be stored with each polygon or segment. This will be reflected in the table contents by the addition of supplementary fields storing reference pointers.

2. Hierarchical information structures

   Some information is organized in a hierarchical manner. Limited hierarchical structure is embedded in the national

Feature Code classification. Where explicit hierarchical references are required (e.g., parcel within block within subdivision) it is necessary to provide the appropriate hierarchical structures within the data base processing environment.

3. Network Data Structures

Substantial land-related data is network based in nature, e.g., drainage networks, transportation and communication networks, etc. Again as required, the appropriate network data structures must be defined and maintained for a full G.I.S. system potential.

Data Processing

It is expected that each site using land-related information will be able to augment their capabilities with at least the following generic capabilities:

a) map display and processing library (provides the capability of managing, manipulating, processing and displaying positionally related data);

b) polygon data management system for the management, manipulation and display of polygon data;

c) digital terrain modelling (as appropriate) for the handling and manipulation of three-dimensional data;

d) thematic and statistical processing systems (e.g., SASGRAPH, GIMMS, etc.).

Each of the above generic packages typically provides a variety of functions to expedite the processing of the associated data. Individual differences may appear between packages of the same type, however, the basic functions appear to be common.

The most important aspect for managing and processing land-related data in digital format is the need for a comprehensive spatial query language. This will often be structured from the DBMS associated with each installation. For a sophisticated DBMS it may be possible to realize the totality of needs for a generalized query language. In other cases it may be necessary to devise languages, specifically, for spatial queries.

DATA MODELS

A data model is the means by which the data organization is depicted. To a degree, this depends on the DBMS being used since the arrangement of the data elements is a function of the actual data model. For example, within a hierarchical DBMS data is structured to reflect a tree organization. In

such cases the data is grouped into segments, each of which contains a specific set of data items. The actual organization of the segments is important.

An alternative data model is based on network structures in which dependencies between data items are built on internal pointers, etc. This model is more complex and requires careful planning since any future changes usually involve restructuring the model at significant cost and effort.

The emphasis today is on the use of a relational model. This model emphasizes the organization of data in terms of "flat" files where each file contains only primitive data items. Each file is referenced by a key (sometimes composite consisting of many fields) and each field depends only on the primary key. There are clearly many advantages to this approach, primarily, conceptual simplicity, with some trade-offs in terms of performance.

For the municipal model it is expected that a relational model will provide the full capability to implement a municipal information system, specifically, for handling the attribute data. It should be recognized that the parcel data base is essentially structured and maintained as a network submodel which is essentially self-contained. In some municipalities it may be seen as expedient to extend the network model for the totality of a municipal information system.

SUMMARY

The provincial models have been structured to reflect what currently exists and what can meaningfully be achieved at this stage of development. The primary objective is to promote a common workable set of georeferencing facilities for general use in processing digital land-related data.

Thank you very much. (Applause)

CHAIRMAN PANTING: Thank you very much, Jim. We now have about 15 minutes for open discussion on the Proposed Model for a Digital Topographic Data Base. George.

Q: Dr. George Zarzycki (EMR): In your study, did you address the question of the density and the content of the data for the digital topographic data base.

A: Dr. J. G. Linders: The question that Dr. Zarzycki asked is: "In our study did we address the question of the density of the data and the content of the data for the digital topographic data base". No, at this point, we did not. What we were hoping to do is to look and see what the real needs were. That is why we went to the various agencies. We were hoping that they would give us some insight as to what was really required, because again the underlying motive for this was, of course, to see whether there is a need for a digital OBM topographic data base. If

there is not any need, then everybody knows where we stand. We found that most people were making do with whatever they could lay their hands on, and I have a funny feeling that the"need" or the clear qualification of that need will only come about as we get more data out there and people start to use it. It is not clear yet. I think if you ask most people what they are looking for, they would say, "Give me some positional information in digital format for a specific set of applications". No coherent picture emerged from the interviews that I was involved in. Maybe in a year's time this will change because people are now starting to move data clandestinely from one organization to another and maybe they will better understand their needs as time goes on, but at this point I do not think this is too clear.

Q: **Unknown Speaker:** Can you give a definition of a base map. Is it a topographic base map?

A: **Dr. J. G. Linders:** I think I know what you are saying. What is being proposed is, of course, the OBM map. We are hoping to ascertain from the pilot projects how valuable the OBM 1:2 000 is for the municipalities. It is expected that the OBM at 1:10 000 is the one that will appear in digital format in Southern Ontario. In the northern parts of the province where another pilot project is being proposed the scale of the OBM will be 1:20 000. What will appear in digital format will be all the planimetric data. There will be no structures associated with them so that you will get sets of contours, sets of rivers, etc. and they will all be classified. We are talking about taking a national topographic series, NTS classification mechanism and using that. We are proposing to use the SIF file format. The SIF file is a format that is used by most of the vendors, such as INTERGRAPH, SYNERCOM, SYSTEMHOUSE, ESRI, etc. That is one of the reasons why it was chosen. We recognized it as a common thread to all of the systems currently used by the Ontario Mapping Industry. What is missing, of course, is topology. So what has to happen is, that data in SIF file format will have to be enhanced by putting in the topology that you require. What topology is required is another issue.

Q: **Eugene Marshall (MNR):** Dr. Linders, how do you integrate data that has been referenced to the same features but on different map bases in which the features themselves are displayed in slightly different position and with slightly different shapes?

A: **Dr. J. G. Linders:** A good question. This is called walking on a plank. Clearly, what Jack said this morning, was that if you are going to talk about data base integration, then topological overlays, as he calls them, are necessary. This means that we have to be able to register our features to one single physical definition, like a particular segment. A line element may be referenced several places but it only appears once. The problem that will exist in the province (because it will be hard to have a single integrated data base approach) is that FRI will have one representation of the lake, people in OBM will have another, people in Wildlife and Fisheries may have yet another if they digitize their own base maps. Others may have picked up an aerial photomap and have digitized that as well. There will then be three or more different representations of the same thing. This leads to problems, clearly, because even if two people digitized the same physical entity and you

overlay these, there will be some deviations. They will not be congruent with each other. I do not think there is much hope of the province overcoming this problem. I think the only hope is in the municipalities where there is much better control. The municipalities have all this within a single mandate under one roof. There is a real potential for data base integration, and I mean real integration. I do not believe that integration is possible in the province at this point in time. Perhaps we must learn to live with this type of data redundancy and the consequences. These consequences mean that when one does polygon overlay, there will be slivers and it will be necessary to clean them up. The polygons may even shift and create other sets of problems. The only way around that would be that people take a common base and reference their data to that common base. I personally believe this will not happen. I do not like this, but this is what I believe.

Q: Frank Raymond (MNR): Is not your concept of doing things to go to a less accurate base?

A: Dr. J. G. Linders: Not really. Why should we? I believe that it is important to constantly improve the base, because if you digitize, let us say a lake, and other people are registering to that lake and you improve the registration of that lake, what you have done is improve the registration for everybody else. You only changed one thing, and everybody else has benefited. As it stands now, if you digitize a lake, and I digitize a lake and I get a better definition of the lake, the option that I have is to give you my copy of updated information and for you to update your data base which could have some severe consequences, which we all appreciate.

Q: Frank Raymond: Dr. Linders, would you care to go out further on the plank and tell us what the right map base to use is?

A: Dr. J. G. Linders: Why not, however, discretion being the better part of valour, I would like to refer the question to John Kerr. Also perhaps John should answer the question that the 'computer chap' asked.

A: John Kerr: While in agreement with most of what Dr. Linders has said, I can't agree with his statement that people will not use a common base map. I believe there is a high probability that the Ontario Basic Maps, when digitized, will in fact be used by a variety of different application areas. In truth, it will be a long time before they are used in a true data base sense with on-line access to anyone wishing to acquire topographic data in real time. We have reviewed some of the complications such a data base entails such as communication links between all major centres in Ontario, high level interfaces between a variety of computers and their different operating systems, compatible/non-ambiguous data dictionaries for all thematic applications which would be accessing the topographic data base or any thematic data bases, and automatic updating of all affected data bases upon update of the topographic data base. These facilities are still a long way off but some are worth striving for. A few years ago, data storage was a major obstacle to on-line access but the capacity of storage devices is continuing to grow and in a few years it should be possible to get a device that could store thousands of OBM digital maps on-line.

The on-line merging of data from different land-related data bases in the province is not only physically difficult to achieve, it is also administratively difficult in that as Dr. Linders has said, "the concrete has settled in many provincial systems" and it would be extremely difficult to justify a complete redesign and restructuring of many of these systems to accommodate their on-line use of a digital topographic data base.

But what is practical at the present time is to: exchange between provincial agencies magnetic tapes containing topographic and other land-related information - develop a common interchange format so that the data on these magnetic tapes can be used on various systems - ensure the OBM maps in digital form are non-symbolized position files which conform to a common interchange format and use standard agreed upon feature codes. In this way, the topographic files can be updated on any one of several systems in use and they can be enhanced to meet user requirements for specific applications and as well they can be plotted using customized symbology for any given application.

It is also practical, at this time, to encourage the use of the OBM base by all the thematic users who can use it. In time, this will simplify the correlation of the different types of thematic data.

Dr. Linders showed a slide earlier in the program, which illustrated that there are three extensively used base maps in this province, the NTS produced by the Federal Government; the FRI produced by the Forestry Group in MNR, and the OBM produced by the Surveys and Mapping Branch, MNR. The FRI base has been around for some thirty years; it is a good base on a projection something like Lambert Conformal. Prior to the OBM, it was the only large scale (1:15 840) map base available for large portions of Ontario. The Forestry Group is on record as stating it will move to the OBM base as it becomes available in digital form for large portions of the province. Currently, some 200 digital FRI maps in Southeastern Ontario are on the OBM base.

With respect to the NTS series, we expect to digitize a series of OBM maps in the next few years in the Niagara Region. Copies of digital, non-symbolized position files will be turned over to Energy, Mines and Resources Canada who in turn will attempt to join them together and produce an NTS 1:50 000 scale map sheet from them. Because the map features will be classified using the National Feature classification coding system and because the digital files will be non-symbolized position files, EMR should be able to produce NTS type maps with the features symbolized according to their own specifications.

The Ministry realizes that all users of the digital topographic base will not be satisfied with non-symbolized files. It is intended to enhance these files over time to meet the needs of more and more users, but for now unless all maps are produced on the same type of system we are forced to deal with non-symbolized files. The alternative is to develop interpreters between all systems.

There are many other potential users of digital OBM base maps including

Bell Canada, Conservation Authorities, Engineering Companies, Municipalities, POLARIS, Ministry of Health, Forest Fire Management, Hydro, Geology, land use planners, etc.

As more and more groups use the digital topographic data base, its utility, relative to the cost of producing it, will grow as it becomes easier to overlay and correlate the various types of thematic data related to it.

It is true, not every one will use the OBM map format. Some prefer the township format or an administrative unit format, so we need a capability to join these OBM digital files together and window out that portion needed by different users. In time that will come. (Applause)

Q: Russ Watson (City of Toronto): Dr. Linders, do you think the digital maps you will be developing through these pilot projects could be used by the municipalities to control parcels digitized from existing plans and do you see any other municipal uses of them? Also, it seems your OBM program has concentrated on small municipalities and ignored the larger ones.

A: Dr. J. G. Linders: Again, I would like to refer that question to Mr. Kerr.

Q: John Kerr: Russ, do you mean the digital topographic maps or the digital parcel maps?

A: Russ Watson (City of Toronto): The digital OBM.

A: John Kerr: We have considered using the 1:10 000 OBM in digital format as a framework for parcel maps. In fact, POLARIS has done this in sections of Oxford County and we are going to do it in Cambridge. We will also use any available digital 1:2 000 OBMs in Cambridge to help control the parcel locations. I personally think the 1:2 000 OBM in digital form would provide a much better framework than the 1:10 000 map. As you already know, when the Ministry enters into a cost shared mapping program with a municipality for 1:2 000 mapping, usually one of the maps produced will contain all the land parcel boundaries. So we are, in fact, fitting parcels to the OBM framework now in hard copy form. I understand Mississauga is considering using the OBM base as a framework for a digital parcel map base it is planning. The 1:10 000 OBM will, I think, be used by municipalities more as an index for indexing larger scale maps, streets and so on. I believe the digital 1:10 000 OBM will be used by some municipalities to generate a street network system. But as several others have already said before me, while municipalities have a need for topographic maps, their major need is for parcel mapping. It is the parcel that most municipal data is related to.

Cy Osborn who is responsible for the management of the OBM program, will be giving a presentation tomorrow; he will probably tell you how many municipalities have applied for 1:2 000 OBM mapping. The list is long, well over 200. So there appears to be a need for 1:2 000 OBM in municipalities. The arrangements are first come, first served. It so happens many smaller municipalities got on the list first. I suppose the larger municipalities felt they already had adequate mapping. I am sure there has been no attempt to ignore the larger municipalities or any

municipality for that matter.

With respect to our questionnaire on digital mapping, it is true we usually only send them out to municipalities with populations greater than 20,000. This seems to be a practical cut-off point. If anyone else feels we are ignoring anyone, please speak up, this is your seminar and your chance to be heard. We are anxious to have input from all concerned parties. What we have expressed regarding the user needs study was the results of our findings and subsequent analysis. It is not necessarily in agreement with what we believed before doing the study, but it is what we found. We have no axe to grind. We are simply reporting the facts as we found them and are attempting to do what is best for the majority with the resources available.

CHAIRMAN PANTING: Any other questions? No, then thank you very much. (Applause). Just a reminder, refreshments are being served next door at 4 o'clock and the workshop starts at 7:30 tonight in this room.

SESSION CHAIRMAN INTRODUCTION, DECEMBER 13, 1983

J. H. O'DONNELL: I would like to introduce today's Chairman: Ray Scott, who is with the Ministry of Consumer and Commercial Relations. Ray graduated from the University of Toronto in 1957 with a Bachelor of Science Degree in Forestry. He was received as an Ontario Land Surveyor in 1959. In 1973, after some fifteen years' experience in the private sector, Ray joined the Ministry of Consumer and Commercial Relations, Legal and Survey Standards Branch. In 1976 he later transferred to the POLARIS Project and was a member of the team responsible for completing the POLARIS concept's report. Currently, Ray is implementing MCCR's automated property mapping system and is manager of the POLARIS Project. Ladies and gentlemen, today's Chairman, Ray Scott. (Applause)

RAY SCOTT, Manager
POLARIS Project
Ministry of Consumer and Commercial Relations

Thank you, Hugh. Good morning, ladies and gentlemen. I think we will try to get under way as quickly as we can. I have been told that there are some other activities going on in this room tonight and we have to get out by 5 o'clock sharp.

Yesterday we heard how the Ministry of Natural Resources has responded to the request for direction and aid from the municipalities in terms of establishing a land-related information system. We told you how interview teams went and looked at existing systems and talked to people about the trials and tribulations that they had in establishing and maintaining such systems. With that background information they came back and talked to selected municipalities and provincial government agencies, trying to find out from them exactly what it is that municipalities and provincial government agencies have to do with land-related information and what tools they need to do it. On the basis of that the Technical Advisory Committee formed some ideas, some concepts, of what sort of information is needed and how it could be manipulated and what sort of products should come out the other end. Having done that, they also have formulated some ideas in terms of how that data should be structured and what sort of models should be built.

Today we are going to take a look at some of the things that are going on in other ministries. You heard yesterday that there are some systems in place, or being put in place, and I think it is important if you work for a municipality about to embark upon an automated land information system, to be aware of these things, if for no other reasons than to understand that there are people out there who may be gathering some information that you need. Although we tend to get deeply immersed in the technical problems of building a land-related information system, and indeed there are problems and differences of opinion and different approaches as I am sure you are already aware of from yesterday, probably, one of the largest problems is

getting the funds to do the data entry that you have to do, because that is a very large job and it costs a lot of money if you are going to start from scratch.

Also since yesterday we investigated to some degree the approaches that perhaps should be taken, we are going to hear today about what the future holds in the area of pilot projects. We will hear what is proposed in order to actually go out and build a model that will prove or disprove some of the ideas and the concepts.

The problem with systems design is that it has to get off the ground on the basis of communication between individuals, which is always a very chancy thing at the best of times. If there is not a true understanding between the people who are going to help you build that system and yourselves as to your own needs, for sure you are going to get a car with the wheels on backwards. I think that if models, working models, are built it is much, much easier for people to understand how they work and whether they serve their own needs, and that is the purpose, I think, of the work that is to come in the future.

One thing that probably bears repeating is the fact that this is not "our" system, the "our" being the people who have been involved with the User Needs Study; it is "your" system, and if we are going to build what you need, we are going to have to have your input right from the start and throughout the entire process. So, I would ask that as proceedings unfold today and opportunities are presented to you, that you ask questions. Tell us about things you do not understand. Voice your opinion if you think that some of the things that have been said do not make sense. You may be a little bit hesitant about standing up and saying, "I don't understand what you just said", but if such is the case, I would ask you to please do just that, because the purpose of this gathering is to provide a forum for that sort of input. That is really what we are looking for.

The first individual that we will have today on the program is our Chairman from yesterday, Barney Panting, and Barney was introduced to you yesterday so I will not enumerate his credentials again. Barney is going to start off by talking about the proposed Pilot Projects. Barney. (Applause)

PROPOSAL FOR PILOT PROJECTS

S. B. PANTING, General Manager
Surveying Services, Surveys and Mapping Branch
Ministry of Natural Resources

Thank you very much, Ray. During the next three years, it is our intention to proceed with Pilot Projects identified as necessary to develop a computerized land-related information system capability in the Province of Ontario.

We know from the nature of the projects which must be carried out to test and prove that capability, that it must be done on a co-operative basis -- one which involves not only the Ministry of Natural Resources, but other ministries that either need a land-related information system, or could benefit by such a system.

We also know that the development of a land-related information system capability is dependent to a very great extent on the capability of the Ontario mapping industry.

Industry must be prepared to deliver the kind of digital product that this province can use in building its digital topographic data base and meet the need for digital files in developing municipal data bases.

And of course, projects cannot be carried out in isolation from user-municipalities. It is here that vital prototypes must be developed to determine what is workable to integrate land-related information systems and what must be discarded. And some of those prototypes might very well become working data base management systems at the municipal level.

Eight products are seen as necessary to the development of a land-related information system capability in Ontario.

(1) First and foremost is the need to develop and enhance the capabilities of the Ontario mapping industry to produce four products. These are:

- a 2-dimensional standard interchange format (SIF) file containing positions and codes of planimetric topographic features;
- a 3-dimensional SIF file containing a digital elevation model in the form of spot heights, breaklines, lake outlines and other discontinuities in the landscape;
- a 2-dimensional planimetric file containing features and contours, symbolized planimetric features and contours derived from a 3-dimensional digital elevation model SIF file; and
- digital parcel boundary files providing UTM co-ordinate values for parcel corners together with associated

parcel identifiers suitably formatted and adjusted for use in the municipal parcel data base environment.

Delivery of these products by industry will require upgrading of their equipment, the development and acquisition of software and the production of test products.

(2) The second involves production of digital maps. A large number of Ontario Basic Maps (OBM) will have to be produced by the Ontario mapping industry during the next few years using digital technology to provide:

- an opportunity for industry to become experienced with the technology required to produce digital maps and to develop effective data collection and procedures;
- assurance that digital topographic files produced on one system, to specified standards, can be used effectively on another system;
- a digital data base and digital terrain model for a variety of application areas. John Kerr will touch on these later in the program;
- a framework for parcel mapping in a specific test municipality;
- a framework for a digital street network system in a test municipality; and lastly
- a street network system in which Statistics Canada blockface data can be linked in a test municipality.

The areas to be digitally mapped would be related to their usefulness in areas of application and include areas of Northern and Southern Ontario and at scales of 1:20 000, 1:10 000 and 1:2 000.

(3) About 25,000 land ownership parcels in the test municipality would have to be provided with Province of Ontario Land Registration Improvement System (POLARIS) unique identifiers and be digitized to provide parcel polygon files, line segment table files and position files, all of which would be loaded into the test municipality parcel data base.

The activity associated with parcel mapping in the test municipality would include:

- digitizing parcels from existing maps
- adjustment to the OBM base
- generation of street network co-ordinates from the digital OBM base, and
- installation of supplementary horizontal control

(4) A series of resource and specialty digital maps will have to be produced using the digital OBM files as a base. This will mean acquiring or developing the

capabilities to join files, window and integrate subsequently digitized data with the base map features.

It also will require topological structuring of the data. This will involve the production of several Ministry of Natural Resources land status plans, forestry maps and geological maps.

(5) It will be necessary to develop a capability in the Ministry of Natural Resources to:

- monitor, validate and enhance digital topographic files for subsequent use by others;
- provide a facility for potential users of the digital topographic data base and to establish a library of generic software routines for manipulation of land-related data.

(6) We would also propose to develop or acquire and implement data base management systems in a test municipality capable of handling and displaying parcel-related data and street network-related data The digital boundary files and the street network files produced by industry would be loaded into the respective data bases. The tasks associated with these activities are:

- acquisition of a data base management system to be installed in the test municipality for handling parcel-related data;
- acquisition of a data base management system for handling and software for displaying street network data;
- interfacing these data bases;
- loading co-ordinate data into the two data bases;
- acquisition of a processor for operating the street network data base as well as acquisition of other peripherals;
- creation of unique POLARIS identifiers for all properties;
- assessment of the test municipality's digitized parcel boundary data for use in POLARIS; and
- compilation and entry into the parcel data base and the street network data base of some parcel and street-related data.

(7) We propose implementation of a parcel mapping system in the Ministry of Consumer and Commercial Relations. Initially, this system would provide digital parcel boundary files in yet another test municipality appropriate for use in the POLARIS system and also for

use by the various departments in that test municipality. This would require:

- acquisition of a parcel mapping system by the Ministry of Consumer and Commercial Relations;
- title document searches and compilation;
- property corner co-ordinate capture for about 6,000 parcels; and
- the use of a consultant for determining the utility and applications of POLARIS generated digital parcel boundary files to the various departments in the test municipality and for implementing some of these applications.

(8) We would also propose to implement a data base management system in a test municipality capable of handling parcel-related data which would utilize the parcel co-ordinates and ownership data provided by POLARIS as a base on which the municipality can develop a land-related information system. We would propose that this be carried out in accordance with the conceptual and functional models recommended by the Ministry. This will require:

- transferring co-ordinate values for parcels in a test municipality from the POLARIS parcel mapping system to a county parcel data base management system;
- acquisition of the appropriate equipment to permit the county to utilize a parcel data base management system;
- acquisition of a suitable data base management system for the county capable of managing a parcel data base;
- acquisition of a suitable software package for the county to display parcel-related data;
- acquisition of a plotting facility and graphic terminals; and
- compilation and entry of some parcel-related data into the parcel data base.

I have mentioned eight specific projects, but that is not to say that these would not be reviewed or that other projects will not be considered during the 3-year life of the overall project.

You might well ask "How are you going to manage such diverse but interconnected projects?" We have devised a team approach to provide ongoing project management from inception to completion.

A joint management team will be set up comprising membership from ministries of the Government of Ontario having direct interest in the project, by virtue of their financial and/or technical involvement in pilot projects, the Ontario mapping industry, the municipalities in which pilot projects will be undertaken as well as utility companies.

The management team will provide overall project direction, establish individual project budgets within the framework of the total budget, monitor project activities and progress, seek advice from a joint technical advisory team on technical matters and review projects. It will also make recommendations respecting the pilot projects, other projects, their objectives, costs, benefits and implementation alternatives.

A joint technical advisory team will be established comprising consultants having expert status in the digital information systems community.

The technical team will function as a source of expert advice for the joint management team and the project development group and assist in reviewing the quality of the products in each project. It will make recommendations and report its findings to the joint management team.

A product development group will be established comprising representatives from government, industry, municipalities and perhaps utility companies. Its purpose will be to co-ordinate product development associated with the projects, prevent duplication and ensure hardware and software acquisitions lead to acceptable standardized products.

As I mentioned earlier, digital products produced by industry for use in developing a provincial digital topographic data base will be monitored and validated in-house by the Ministry of Natural Resources to ensure attainment of established standards, feature positional accuracy and completeness of content.

And finally, a review of all pilot projects will be undertaken by the joint management team fifteen months following start-up. Each project will be reviewed for consistency with original objectives, estimates, specifications, schedule and participation by other potential users and any other aspects which may impact on project direction or completion.

CHAIRMAN SCOTT: Thank you very much, Barney. I think that, that detailed description of some of the pilot projects has stimulated your imagination to some degree and possibly caused you to have some questions. If there is anything you want to know about these pilot projects, now is a good time to ask. Lou Stadelman.

Q: Lou Stadelman (Ministry of Revenue): May I have additional information on Project No. 6?

CHAIRMAN SCOTT: Barney, would you like to respond to that question?

Q: Unknown Speaker: Mr. Chairman, I have a question regarding the POLARIS project. I was at 10 Wellesley last night to see your operations. Speaking as an Ontario Land Surveyor, I was quite interested to find that there is no requirement for surveyors, working in the Tillsonburg area, to co-ordinate their surveys. When you are carrying out pilot projects, would it not be wise to require co-ordinated surveys in the project areas?

A: CHAIRMAN SCOTT: That is another question. I think that when Barney is finished with the first question, I will respond to yours.

S. B. Panting: I just wanted to say, Mr. Chairman, that John Kerr has all the technical details and I would like John to respond to that question.

A: John Kerr: With respect to Project No. 6, our intentions are to digitize existing land parcel index maps in Cambridge. There are about 25,000 parcels involved. We will also digitize the 1:10 000 scale Ontario Base Maps which cover Cambridge as well as a few 1:2 000 scale Ontario Base Maps (OBM). We will fit the digitized parcel maps to the 1:2 000 OBM, where they exist, and to the 1:10 000 OBM maps elsewhere. The POLARIS group will provide the unique parcel identifiers which will form a key for retrieval. We will implement two data base systems in Cambridge; a parcel data base and a street network data base. The co-ordinates for the street intersections for the street network data base will be derived from the OBM 1:10 000 and 1:2 000 maps. It is intended to link the street network to Statistics Canada data in order to do some time, distance districting studies.

We also intend, in co-operation with the municipality, to implement on the parcel data base parts of some other files that are associated with land parcels.

These projects are aimed at providing some of the needed capabilities that the User Needs Study identified. In addition, the parcel corner co-ordinates that have been generated by digitizing will be turned over to the POLARIS group who will determine if they are suitable for use in POLARIS. The POLARIS group, as you know, currently establish co-ordinate values of property corners by co-ordinate geometry. They start with a point for which the co-ordinates are known and using COGO, key in the bearings and distances from existing plans of survey or metes and bounds descriptions in order to derive the co-ordinates of all other points in the area of concern. The question to be resolved in this exercise is the degree of accuracy that is required for parcel corner co-ordinates.

In any event, if POLARIS cannot use digitized values, we want to determine how much upgrading will be required before they can use them. In this way, we hope to achieve an acceptable balance between accuracy and cost.

Lou, is that sufficient or do you want more?

Lou Stadelman: That is sufficient, thank you very much.

John Kerr: Dr. Rowland Tinline.

Q: Dr. Rowland Tinline (Queen's University): (Microphone not used, question not picked up.)

A: John Kerr: I think it does. May I ask to please use the microphones, and state your name and where you are from. It makes it much easier to prepare the transcripts if we have the questions and statements made by the delegates on tape.

Q: Dr. Rowland Tinline: I am from the only group that did not get to raise

their hands yesterday when Jack Dangermond asked how many were here from provincial departments, from municipal agencies, and from federal agencies. He forgot to ask about the universities and I think some of us would like to know how many of the delegates are from universities and community colleges.

A: John Kerr: Let's rectify that right now. How many are here from the academic world? (Applause). (Approximately 25 hands were raised). Also may I ask the Ontario Land Surveyors to raise their hands. (Approximately 65 hands were raised).

Q: Dr. R. Tinline: I am a litte confused about the pilot projects. This is the first time that I have heard about them. Reviewing the list I notice the first couple are aimed at developing and enhancing the Ontario mapping capability. It strikes me that if I were in industry I would be holding off until you complete the rest of the job. What I would want to be assured of is that there is going to be a market for my product, and having been assured of that I would go gung-ho. I was really curious, John, what are you planning to do for the mapping industry in this interim period?

A: John Kerr: Okay, Rowland, it is not only what we can do for industry, it is also a question of what industry can do for us. These projects which we are discussing are joint efforts in which the Ministry of Natural Resources, the mapping industry, three, possibly four other provincial ministries, two municipalities and several utility companies are involved in. We developed them in concert with the other players, we negotiated, we modified them, dropped some and added others. The impetus has been as much from industry as from the government. The Ontario mapping industry appreciates that there is a broad world market with many suppliers. It recognizes it is losing its competitive edge because it cannot provide certain digital products that some groups are requesting. It also realizes the high cost of getting geared up and of doing your own system development. It is our hope that over the next three years, through the development of these pilot projects, the Ontario mapping industry will gain the opportunity to upgrade their equipment and their software and that these upgrades will be co-operative in nature, with government and industry working together. In this way, software produced by or for one company hopefully will be of use to all of them. Thus, there will be less duplication in development efforts.

We will work together in harmony to develop something that is compatible. For example, the specifications for digital Ontario Basic Maps were prepared with the idea of acquiring a non-symbolized position file, on a standard interchange format, from industry so that the Ministry can accept and use digital map data produced on any of the four different systems being used by the mapping industry in Ontario today.

The industry are involved with us and they appear to be very pleased to be so. The Ministry has on file a letter of support from the industry for the entire project, signed I believe by the whole of the Ontario mapping industry. I believe Don McLarty, president of the Canadian Association of Aerial Surveyors is present today. Don, would you like to add anything to what I've said?

A: Donald W. McLarty: Well, John, I think you've covered it pretty well already. The fact is that the industry has to gear up to digital mapping and digital land-related information systems in any event. These particular projects, this program, as far as industry is concerned, is a tremendous boost. It will help the Ontario section of the industry to meet the demands for digital mapping. And the demand is there, the fact is that if we do not acquire the capability, we will lose our edge in international markets in which, right now, we lead the way.

John Kerr: Thanks, Don. Rowland, does that clarify the situation?

Q: Dr. Rowland Tinline: I am presuming then from the answers, John, that the pilot projects are not so much pilot projects as they are development projects and at the end of this you are going to come up with tools that the municipalities will be readily able to use or make choices on hardware and systems that they can put in place.

A: John Kerr: We expect these projects to produce digital map and digital terrain products which can be used by anyone wishing to use them. It is expected that the equipment and software that is acquired by the mapping industry, by municipalities and by the various ministries will also be used by them after these projects are completed, but we cannot guarantee that. We call them pilot projects, because it is possible that some of the things that we are hoping to do, cannot be done.

Q: Dr. Rowland Tinline: Just one further comment. Are we forgetting about some of the data? For instance, the assessment files, probably one of the most potentially useful files for anyone interested in demographic analysis, yet anyone who tries to use those assessment files in any meaningful way finds that they are shot full of holes. It would be a marvelous thing if something could be done about getting the assessment files in place during the next three years.

A: John Kerr: You would have to talk to someone from the Ministry of Revenue about that, Rowland.

Q: Dr. R. Tinline: It seems to me that assessment data is fundamental. We can develop software and hardware but without the data base, we are back to square one.

A: John Kerr: There is no question that assessment data would be a valuable component in a municipal land parcel data base. It is our intention, as Mr. Panting mentioned, to incorporate some files, other than the position files, into the pilot project land parcel data bases for testing purposes. It is possible this could include some assessment data. There is, however, only a limited amount of money available for these projects and the municipalities, ministries and industry are already committed to a considerable amount of money. Revenue did not choose to become involved at this time, so who would you suggest should pay for compiling and loading the assessment data? Fortunately, there are a fair number of groups sufficiently interested in these projects to put up the money to do what we have already outlined.

The thing is, if we work together, sharing the cost of the development and

the products, we can all get more out of these projects than what we put in. Not only that, but we will also establish joint standards, procedures and products, thus increasing our chance of coming up with products which are acceptable to all. That is our goal. I cannot see any better way of doing it, so we are all working together and we are all putting dollars into the pot.

Q: **Bob Madill (Systemhouse Ltd.):** John, these projects certainly provide industry a marvelous opportunity. I wonder if I could pursue this just one step further. We are, of course, from systems and the software side of the industry, and noting in these pilot projects, there certainly are challenging opportunities here. One, for example, the development of fairly broadly based interchange files for manipulation of this information. John, we certainly would welcome the opportunity in our industry to participate in assisting you to make these things more available, more widely able to be shared among the various members of the surveying and mapping community. If there is a formal means by which we could participate in this process, we would be most pleased to do so and put in the time to do the work and assist in every way we can.

A: **John Kerr:** Bob, there will be a management committee the membership of which is comprised of representatives of the Canadian Association of Aerial Surveyors, the ministries and municipalities who are directly involved in the project, and one or two utility companies. All participants have committed substantial amounts of money to the various projects and each contributor will have a representative on the management committee. The management committee will make the decisions on the bulk of the software acquistion and development. I suspect, however, much of the software required will be purchased from existing systems with a limited amount of software development taking place for the creation of interfaces. I am sure that there are several potential members of that management committee in the room and they can take your statement under advisement. Are there any other questions with regard to these projects?

CHAIRMAN SCOTT: I like what I am hearing, I think we are beginning to stimulate you a little. While there are other questions, I have one that I should respond to and I know Ron Logan has one. We would like to have a workshop where you people have a chance to get involved and an opportunity to say what you wish. The problem is in trying to keep some semblance of order and stay on schedule in order that you can leave here by 5 o'clock tonight. There will be an opportunity this afternoon for group discussions and so, although I would like to let this discussion continue, I'm going to interrupt it and give Ron Logan a change to ask a question that he is anxious to get an answer to. Ron, will you present your question to us? I know you have a tendency to stir things up a bit. If the rest of you would just hold off on your questions for a few minutes, I'm sure you will get the opportunity to ask them before we leave today.

Q: **Ron Logan (MCCR):** I am with the Real Property Registration System of MCCR. I have two questions relative to the pilot projects but John has answered the first one which dealt with the administrative structure that is going to oversee and direct the projects. The second question relates to updating the parcel base. Yesterday there was a lot of discussion. When we were reviewing the functional models regarding updating, there was talk

about digitizing and being able on a transaction basis to automatically and simply upgrade the quality of the base. I would be interested in hearing some more comments on that relative to Project No. 6 which John mentioned.

CHAIRMAN SCOTT: That sounds like a lovely question. Who wants to reply to that, John, Jim?

A: John Kerr: Ron, you might recall that the parcel data base design that is recommended contains, amongst other things, a co-ordinate position file. Also that we are referencing the co-ordinates to a common base, the UTM grid system. Thus, providing the parcels, their boundaries and their corners are all topologically related, when the co-ordinates of one corner of a parcel are changed, so too will be the associated entities such as the boundaries which emit from it.

As co-ordinate values on property corners are upgraded through integrated surveys, the representation of the parcels and associated spatial entities in the parcel data base will become more exact. It is assumed the co-ordinates will be stored in the parcel data base as will keys such as the street address, unique parcel identifier and roll number. It is expected, therefore, that a parcel could be accessed through one of these keys, the co-ordinate values updated by keying in new values and hopefully all the affected adjacent parcel corners would be upgraded accordingly. This appears to be one of the advantages of a topologically structured data base system over a graphic system. Wouldn't you agree, Jim (Dr. J. G. Linders)?

Dr. J. G. Linders: Yes.

John Kerr: It appears Ron Logan would also like to hear from you, Jim. Would you care to respond from where I've left off?

Dr. J. G. Linders: I am not sure that I can add more to it, except to say that we recognize that it is important to get a parcel base system going as quickly as possible with the best graphics that are currently available. We recognize that the most important aspect of this activity is to build a data base. When the data base is built, we will have the capability of maintaining and updating the information base with little effort. As John has suggested, if we have to upgrade the quality of the parcels, this means upgrading both descriptive information and positional information. The descriptive data will, I assume, come from other sources than those which municipalities have direct access to. Positional information can also come from a variety of sources. It could come from surveyors and be displayed on registered plans of subdivision or be generated by the municipality or it could come from POLARIS. I anticipate POLARIS will be a major source of input for this data, and that once this data is input it is not entering a single data point. The comment I made yesterday emphasized the importance of consistency checks on all the data as it enters the data base. These consistency checks will be defined by the type of data that we are dealing with. As John implied, if we have a data point which is shared between a number of parcels, then what will happen under update is that when a particular co-ordinate value is changed, all the parcels which share this point and all the administrative boundaries which share the point, either as in terms of defining the

boundary or in terms of being a cadastral corner, would automatically be updated in the data base. It may be that you and I should spend some time later today and if necessary we will work out more of the details. I can show you the state transition diagram that we propose would be in effect in order to really do this. Thank you.

A: CHAIRMAN SCOTT: Thank you, Jim. Let me try to respond quickly to the question that was put to me before we move on. The question was that there is nothing in place right now that is asking Ontario land surveyors in Tillsonburg, which is one area in which the POLARIS Project is mapped, to tie their surveys into the control network that is there. I think that you will recognize, certainly the land surveyors who are here recognize, that we need legislation and the necessary density of control to do that sort of thing. The POLARIS Project in mapping that area has made use of the co-ordinate values that were there. Now it was a local co-ordinate net and we had that tied into some MTC control stations and transform to 6° UTM co-ordinates, but, I guess the best answer that I can give to your question is that the nature of the mapping program that POLARIS has is to provide a system which is both updatable and upgradable and hopefully that day will come when surveys are in fact tied to the co-ordinate system and we are able through the process of accepting and recording surveys in the land registration system to get the information we need to upgrade the co-ordinate values we have. But right now we do not have things in place to make that happen.

I think we better get along now, because we are already sagging as far as our schedule goes. The only thing I will say before I introduce the next people, I think, recognize it or not, that what we are still skirting around here and bumping into is the matter of accuracy. You heard quite a bit about it yesterday, there is a diversity of opinion. I, for instance, have some views on accuracy that do not toe the party line, and I think I have to get my licks in before the day is over. You are going to hear some more about it this afternoon, when we hope that we are going to get you people to discuss as groups accuracy, one of the things we hope that you will discuss.

In any event, we hope that you will keep up your participation that has started off this morning. I sort of debated with myself whether I should start off this morning in my remarks by mentioning that yesterday we did not get a great deal of response. We are in some rather esoteric areas when Jim begins to talk about the conceptual models and some of the data processing problems. We moved into areas, I think, that leads you to get your hands on, and that is good, but beware that the sort of things that Jim Linders and Jack Dangermond were talking about yesterday, have not gone away. You are going to have to meet these sorts of things head on, and I do not really think that they are as difficult as you might think. I think, it is the language that is difficult, that is part of the problem.

Anyway, let us move along. You have heard about the pilot projects that have been proposed and you have heard yesterday about the municipalities that were interviewed and we are going to hear now from representatives from those municipalities so that they can give you their views on the interviews that took place and the work that they see as it has progressed to date and what is proposed for the future.

The first person that will speak to us is from the City of Cambridge and it is John Sobura. John is Assistant Director of Data Processing with the City of Cambridge. He started out working with the Metro Trust Company as a Computer Operator Programmer, he moved from there to Cooper Energy Services as an Operator Programmer and a Program Manager and currently he is Assistant Director of Data Processing and a Program Analyst with the Corporation of the City of Cambridge. Some of John's other involvements are Chairman and Member of Cambridge Digital Mapping Task Force, and the Regional Geographical Referencing Information Systems Task Force. He is on the Steering Committee and Investigative Subcommittee as well. John. (Applause)

PANEL DISCUSSION

MUNICIPAL PERSPECTIVES

JOHN SOBURA, Assistant Director
Data Processing
Corporation of the City of Cambridge

Thank you very much, Ray. Good morning, ladies and gentlemen. My topic, which deals with some of the events which took place in Cambridge within the last two years, hopefully will reflect some of the trials and tribulations that some of you have been through or are about to go through in the near future.

My official title is Assistant Director of Data Processing. My fourteen years in data processing environments predominantly revolved around manufacturing and municipal applications. The concepts of automated mapping and related information systems have not entered into our policies until just recently. The reason I am mentioning this to you is to emphasize the challenge put to us when in 1982 we were selected by our Municipality to formulate a digital Mapping Task Force. Some parallels can be assumed at this point because, from my experience, I am sure that a lot of municipalities, like Cambridge, are finding themselves in a situation where you have data processors who virtually know very little about mapping, and you have mappers who know very little about processing their data electronically. The third parallel, of course, would be current budget practices by municipalities.

However, in Cambridge, we were assembled and soon established a mandate to; firstly, determine the value of a single mapping function to satisfy our requirements; and, secondly, to implement some long-range plans to establish an automated system in Cambridge.

Well, determining the feasibility of a single mapping environment for our Municipality was relatively simple. All one had to do was keep in mind that Cambridge was a composite of three municipalities, which were Galt, Preston, and Hespeler; meaning, we had a mixture of maps with no standards which could help us come together smoothly. Another complication which we really did not need, was that until 1982 the various departments within our Municipality were dispersed in three or four other buildings. This meant, obviously, we had a major problem; divisions were collecting data to satisfy their particular needs with a storage and retrieval style completely independent of each other. This not only meant duplication of data, but in many instances, duplication in effort to obtain this data.

Our second task, which was to implement some long-range plans for establishing a single mapping system was both difficult and confusing. On top of learning what each department's needs were, we had to learn new terminologies and technologies.

Our learning curve had, in fact, become a very steep upward trajectory. We realized, in a relatively short period of time, that the system we required to do the job properly was one which would assist not only our mapping requirements, but those of the regional government, utility companies, and developers as well. All of these links were vital, and yet at the same time it was developing our compact little ideas as a municipal information system into a complex data environment.

By now, we have concluded that an error in judgment could prove to be very costly; so, we embarked on a massive reaching out campaign. We began by going through M.I.S.A.'s (Municipal Information Systems Association) manual on computer application and began to visit or talk to any municipality which had even the most remote application dealing with Geographical Referencing Information Systems. We also visited any utility companies which had their applications computerized.

We finally gathered enough data to establish a plan, with some completion dates attached, for the implementation of a system. Still, not being too sure of our approach, we kept in touch with the Ministry of Natural Resources. John Kerr would meet with us, encouraging us that having a committee was a step in the right direction, and that our goals were not unreasonable.

With a new found enthusiasm, we decided to utilize some core within our existing computer system which was used primarily for accounting applications. We began getting our feet dampened, by cataloguing our maps and indexing them for reference. We would, at least, be able to start sharing our data within each mapping division. This would include access to the data by map number or by street name. Each department would receive a current list, demonstrating detail information about each map and its location. We realized this was a short-term need, but one that all the mapping divisions felt was necessary. This was also a good way to review what state our mapping data was in, i.e., scales, age, etc.

Now, this is as far as we have gotten in 15 months' time; during that time we were sending mapping staff to courses and seminars to familiarize them with computers as they relate to mapping. However, from this point on, is a combined Cambridge and Ministry of Natural Resources saga. The next several months I will not detail because I would be repeating what the Ministry, through John Kerr and Jim Linders, have already said.

However, what was important to our Municipality was now we were selected for a user needs study for a Geographical Information System. This meant working with experts in the field of mapping systems. We would receive an analysis of our requirements and recommendations on hardware and software which would satisfy those requirements.

The pilot project, which would involve a municipality willing to commit some funds was an added bonus. All we had to do was convince our council to part with a total of $150,000 at $50,000 increments over the next three years.

Although we have received council approval and we are pleased with the recommendations the Ministry of Natural Resources has put forth, we would

have been equally pleased to see the project go to any municipality because we would now be able to observe what an automated cartographic system would entail. Problems encountered could be avoided; we would see current technologies (both hardware and software) applied to a municipality; costs in building such a system would be available; training and staffing requirements would be evident and on and on. In other words, this is the type of setup we were hoping to learn from when we searched Ontario for guidance in building our data environment. The important point is that the Ministry of Natural Resources has recognized this requirement. (Applause).

CHAIRMAN SCOTT: Thank you, John. Our next speaker comes from the County of Oxford, and it is Peter Archeson. Peter is the Planning Commissioner for the County of Oxford. In 1968 Peter got an Honours B.A. in Geography and Planning from the Waterloo Luthern University. In 1970 he received a Masters of Science and Planning from the University of Toronto. And from 1968 to the present he has worked as a Planner for various municipalities and in the private sector for Marshall Macklin Monaghan, and as I said he is currently Planning Commissioner for the County of Oxford. Peter. (Applause)

J. PETER ATCHESON, M.C.I.P.
Planning Commissioner
County of Oxford

Mr. Chairman, fellow panelists, ladies and gentlemen:

I must confess to you that it is with mixed emotions that I am participating in this land-related information systems seminar. It is, for me, exciting to listen to people like Jack Dangermond and Jim Linders speak to you about their activities in developing land-related information systems models. It is a bit like a peek into the future, in which one is looking down a long tunnel, the images are there, but they are shrouded in mist and are not always clear.

Hopefully, seminars such as this and the demonstration projects as outlined to you by Barney Panting will bring these images into clearer focus for consumers such as the municipalities that I represent.

The second emotion is one of fear, based on a lack of understanding of the terminology and buzz words of the industry; for as a neophyte in this whole area to stand in front of you and give you a municipal perspective on land-related information systems seems almost absurd, a bit like the blind leading the sighted.

Perhaps the best piece of information I may impart to you is something about John Kerr, for when John asked me to speak to you, I must admit that I did my very best to get out of the job, pleading ignorance in this particular field of knowledge; but for any of you who know John Kerr well, and as I found out, the word "no" is not part of his vocabulary. So here I am, a municipal planner, with nothing more than a smattering of knowledge in the field of computer systems and land-related information systems, in front of you to give you a municipal perspective, that of the County of Oxford, on what we see of the Municipal User Needs Study conducted in Oxford and the City of Woodstock this year and what we hope for from the demonstration project to be caried out in our municipalities.

By way of a brief background, may I first tell you a little bit about the County of Oxford. The County of Oxford is a reorganized municipality in the Province of Ontario, with a total population of about 85,000 people. The county is comprised of eight municipalities - three urban and five rural, with the City of Woodstock the largest municipality of approximately 27,000 people being geographically located in the centre of the county. There are presently within the municipal governments of the county four mini-computers; one in the City of Woodstock, one in the Town of Tillsonburg, one in the Treasury Department of the county, and another computer in the county's Engineering Department. All of these systems are used for accounting and tax billing purposes, and the system in the county's Engineering Department is used for both accounting and the job costing of engineering projects.

The other significant activity presently under way in the County of Oxford, which has implications for the development of a land-related information

system, is the POLARIS project being carried out by the Ministry of Consumer and Commercial Relations. This is a demonstration project whereby the deposited information in the county Registry Office is being computerized. At the same time, the POLARIS project is establishing computer maps of the land ownership parcels fabric of the county. This could be a vital first step in the development of any land-related information system for our municipalities. It is my understanding that Ray Scott from POLARIS will be giving you an update later in the seminar; however, I think it is, from our perspective, significant for you to know that such a program is presently being carried out within our municipal jurisdiction.

When one sees demonstration projects of land-related information systems and interactive graphics in action, the initial reaction from the perspective of the municipalities that I represent, with nominal computer systems in place and a manual system for generating all land-related information, is one that runs through the full range of human emotions; from exhilaration, when one considers what might be done, and how the drudgery of many data collection and map making tasks could be reduced and the quality of such maps improved; — to one of fear and intrepidation as it relates to the cost of such systems, their maintenance and operation. A fear based upon our perceived inadequacies or a lack of understanding the operational details of such systems. These fears, from the viewpoint of a layman, are the result of a lack of understanding of the buzz words used by the experts in the field and in many cases are manifest in a fear of not knowing even the right questions to ask.

If such systems are to be recognized and accepted by the consumer, i.e. municipalities that I represent, such systems and their designers must communicate in plain English with the potential consumers of their systems.

The need for a dialogue between the consumers and the designers of such systems was vividly brought home to me during the Municipal User Needs Study that was conducted in our municipality this summer. A great deal of time and discussion was needed for us to adequately explain the many functions and aspects of our operations, which seemed clear to us, to the interviewers. We all spoke English but many words had different meanings. Similarly, a great deal of time was needed for the interviewers to adequately relate what we had told them to the study process and with only a short time to review our section of the study. I am sure further refinements would have to be made.

From our municipal perspective, the major advantages of such systems being in place are clear in the reduction of the duplication of effort and in the improvement of the quality of our data base, as well as in our ability to access that data for various tasks. In municipalities of the size that I represent, many of our decisions are made on an intuitive basis simply because we cannot access quickly and cost-effectively the data that we need to make judgments on any given project. With improvements in data capture and its availability to us, hopefully we could see a corresponding improvement in the quality of our municipal decision making as it relates primarily to long term capital projects, and our ability to deliver appropriate services in an economy that is not expanding as rapidly as in the past.

In the area of data capture over the last five to ten years, we at our municipal level are discovering that the tradition methods we used to use for acquiring statistical information has moved from a hard print medium to the computer tape. If we do not acquire the necessary systems to access this information we are going to be left behind. It is an interesting paradox that with more data and information available fewer people are able to access and effectively use it.

It would seem, from our perspective, that such land-related information systems and interactive graphic systems would appear to offer certain economies of scale. However, to date, almost every system that I have been exposed to, and these are not many, the costs of establishing the systems have been far beyond the original forecast estimates.

The original conclusion from our perspective would be that these economies of scale can only be achieved through a co-ordination between provincial ministries and their departments, and local governments and their various departments. This co-ordination and co-operation will be required, in my judgment, not only in the initial establishment of a land-related information system, but also in the ongoing maintenance and upgrading of the various files within the system.

With proper co-ordination and standardization, the data capture and flow of information could be multi-directional, not just from the province to the municipalities but from the municipalities to the province and from municipality to municipality.

While it is easy to state that such co-ordination and co-operation are necessary and are in everyone's interest, if a clear method of establishing such is not forthcoming, the cost of establishing a land-related information system and the generation of the initial data base, in many cases, will make such systems a luxury that cannot be afforded by municipalities such as the ones that I represent.

The perspective that our municipalities must take with respect to the establishment of a land-related information system is one of a wary consumer. From our perspective, such a system needs to prove that it can be:

(1) reliable;
(2) simple to use;
(3) easy to maintain; and
(4) cost-effective;

with tangible visible benefits to our board of directors, namely, municipal councils.

The excitement that this new technology arouses in any future-thinking individual will be blunted if the new systems cannot be judged by these criteria.

In reviewing the Municipal User Needs Study conducted by the Ministry of Natural Resources in our municipality earlier this year, it is our initial

feeling that if a municipal land-related information system is to be successful, it must have the following characteristics:

1. There is a need for standardization in the method of data capture for the various ministries, local governments, and other agencies, etc. that are presently producing this information on an independent basis.

2. There is a need to ensure that the various computer systems used by the various levels of government and their agencies, and the data that these computers use and generate, are compatible with one another.

3. We see a need to prove that such systems are cost-effective and in order to achieve this in municipalities of our size, there will have to be a multiplicity of users of the system in order that the full benefits of economies of scale that such a data base could produce can, in fact, be provided to a wide range of users.

It would seem to me that the various players in the municipal data collection system must input into any land-related information system, and must not proceed in a discreet or independent fashion. It is my gut feeling that land-related information systems and the development of data base files will never be cost-effective in municipalities of our size if we were to proceed on an independent basis. I intuitively believe that the demonstration project for our municipalities will prove itself cost-effective only if we can co-ordinate the use of such systems among the various potential users in our area.

I am sure that the Warden of our County, Mr. Charlie Tatham, who is also an Alderman in the City of Woodstock, would think I was remiss if I did not say that the County of Oxford and the City of Woodstock were pleased to have been selected by the Ministry of Natural Resources as test municipalities in their Municipal User Needs Study. We are equally pleased to participate in the demonstration project outlined to you this morning by Barney Panting. We hope that the project can demonstrate clearly that through co-operation between the various levels of government and between ministries and local governments, that a land-related information system cannot only improve the way we at the municipal level use and display data, but also that it will prove that such a system can be cost-effective for other municipalities of our size.

I was reminded the other day of the speech given by a mayor of an Ontario municipality, now a cabinet minister in the Provincial Government, who was addressing a conference of municipal politicians. He told a story about the three most common white lies. The first one was "your cheque is in the mail"; the second was "of course I will love you tomorrow as much as I am loving you now", and the third one was "we are from the province, and we are here to help you". In some cases, that type of skepticism between provincial and municipal relations was well founded; however, I must tell you from my perspective in dealing with the Ministry of Natural Resources as a lead ministry in the Municipal User Needs Study that they have conducted earlier this year, we have found nothing but a high level of

co-operation and a genuine desire to discover the best method or methods of developing a land-related information system for the Province of Ontario and its municipalities. From that point of view, I have personally been delighted in working with the province on its study to date, and we are looking forward to working with the Ministry in its demonstration projects.

I am convinced that if the type of co-operation between provincial and municipal bodies that has been exhibited so far can continue, the program outlined to you by the Ministry yesterday can be nothing but a success and of benefit to everyone in the Province of Ontario.

Thank you very much. (Applause)

CHAIRMAN SCOTT: Thank you very much, Peter, for sharing with us your views on the things that you see are exciting and also your concerns.

I certainly share your views that you expressed in terms of co-operation. I think with the amount of information that is out there today that all levels of government have to handle, the only way that we are going to be able to make use of the new technology that is available to us, is to co-operate in terms of the collection of that information and developing the systems that will handle it.

You can hang on for a little while longer, we will get you some coffee shortly. We are running about 15 minutes behind.

The last speaker is from the third municipality that was involved in the User Needs Study which was Mississauga. The speaker that we have next is Robert Johnston. Robert graduated from Waterloo Luthern in 1970 with a B.A. in Political Science. He was a licensed real estate broker for five years, and is currently the Director of Realty Services for the City of Mississauga and has been in that position since 1979. He is responsible for the acquisition, disposal and management of City property. Bob. (Applause)

ROBERT K. JOHNSTON
Director of Realty Services
City of Mississauga

Thanks very much, Ray. The City of Mississauga considered it a privilege to be selected as one of three municipalities taking part in the User Needs Study sponsored by the Ministry of Natural Resources. As background, the City of Mississauga was formed in 1974 when the Towns of Mississauga, Port Credit, Streetsville and part of Oakville were merged. This amalgamation caused several problems. Each municipality had different standard levels of service and information data base. Mississauga over the last ten years, has been one of the fastest growing municipalities in Canada, if not North America with a current population of 325,000. As a result of this rapid growth, the City has had trouble in maintaining up-to-date and accurate graphic information. A by-product of the rapid growth of the City is the rapid growth of the municipal bureaucracy. There is a growing need to centralize land-related information to reduce duplication and increase efficiency and the level of service to the taxpayers. Economic restraint has also caused us to look at the various systems within our municipality and the cost/benefit of automated data retrieval.

The City has not had an overall strategy for the ultimate development of our data files. An Information Systems Steering Committee was established two years ago to review user requests and to ensure that any information systems proposed for various departments are compatible with other existing systems within the City and are not contrary to the objectives of centralizing information systems. Nevertheless, many files have developed for land-related information. Linkages were included in the original files that were designed but these links are ever increasingly becoming more feeble as more files are being developed.

When Mississauga applied to the Ministry of Natural Resources as one of the municipalities for the User Needs Study, it was with our eyes wide open and with realistic expectations. We knew that regardless of the conclusions of the User Needs Study and the conceptual model design of a land-related information system data base, the City would benefit in the fact that all the land-related tasks of the City and closely related agencies, such as the Regional Municipality of Peel, Hydro Mississauga and the Peel Board of Education, would be catalogued and available for future studies that could be initiated by the City. We also anticipated that by participating in the User Needs Study that this would upgrade our inhouse expertise and understanding of the graphic information system structure. The City also looked towards developing an inventory of the information types and flows such as development control, maps and evaluation of these information sources.

Criticism of Study

The two people carrying out the User Needs Study in the City were sufficiently knowledgeable of land-related information systems. However, in carrying out their interviews, there was a difficulty in communicating

with the various departments in the City. I would suggest that a primer be prepared outlining the concepts of a graphic information system with definitions of the various terms used and examples of graphic displays. The City was impressed with the amount of time and the thoroughness of each of the interviews and their concern for accuracy in the preparation of their report. What did concern us is that we were given to understand that the City would participate in a steering committee composed of the other two municipalities in the study and the various provincial ministries involved. There was very little communication between the City and the province after the interviews were completed in June and the proposal made to the City in October to participate in a pilot project. There was no municipal input in identifying the generic task or developing the conceptual model. The City was left with the impression that the conceptual model had been developed in advance and the User Needs Study was only a rubber stamp to confirm the design of this model. I emphasize that I am not saying that this is the case as obviously the conceptual model has been developed over a number of years. The City was offered the opportunity to participate in a pilot project to develop a street network which would be developed from 1:10 000 scale Ontario Basic Maps and would be used to develop a single line street network. A street network would be of benefit to the City for districting, routing of transit, garbage pickup, school buses and accessing Statistics Canada data at the blockface level. The City's priority is still for an accurate up-to-date parcel data base with topographic overlays.

The City departments that have been involved in the study are not convinced that the street network data base is the right direction for the City of Mississauga to move at this time. We also have a concern regarding the accuracy of the topographic mapping. It is our opinion that the 1:2 000 OBM would be more appropriate for our needs.

Our strategy is to be designated an integrated survey area. We hope to accomplish this by first densifying our horizontal control network and entering our network into COSINE. The City is now amending its engineering agreement to require developers to provide horizontal control in new plans of subdivision and in situations where it is not economic for a developer to provide horizontal control, a cash contribution will be requested in lieu of control. As soon as our horizontal control network is sufficiently densified we will request the Ministry of Natural Resources to designate Mississauga as an integrated survey area. We hope that this can be accomplished within a period of five years.

The City is looking at digitizing existing parcel maps to determine what difficulties will be encountered and the cost of such a program. During the period of the User Needs Study, the City was somewhat at odds with the province with regard to what accuracy is required. It is our objective to ultimately develop a highly accurate system. However, we recognize in the short term we are restricted by the cost of data collection. It is my understanding that data collection is approximately 85% of the cost of any graphic information system.

Council has endorsed the recommendation that a staff committee be formed to evaluate the feasibility of developing a comprehensive graphic information system and preparing a 5-year strategy especially for budgeting purposes of

implementing such a system.

As everyone has emphasized over the past three seminars, there must be compatibility not only between the municipalities and the province but also within the municipalities themselves. It is difficult to wait patiently while the pilot projects are developed and evaluated. My understanding is that a G.I.S. will take approximately five years to develop. The pilot projects will probably reduce this time period along with the ever changing technology but for all of us here today working towards developing a system, it will be the end of the decade before you will see the end product.

Recognizing the development time, we do not want to stand still until the pilot projects are completed and lose whatever momentum we have gained from participating in the User Needs Study.

To ensure compatilibity, we intend to keep in close contact with MNR and especially Ray Scott and POLARIS. It is my opinion that the Ministry of Consumer and Commercial Relations and the Ministry of Revenue should play a much larger role in the development of the parcel data base in municipalities and be prepared to participate financially in developing a parcel data base.

A fund could be established by MCCR by levying a small surcharge of $5 to $10 on all transactions at the Registry Offices to subsidize the creation of a parcel data base.

I am also concerned that the Ministry of Revenue is not showing any leadership in developing graphic information systems. Historially, the assessors maintained parcel maps for municipalities. Now, because of financial restraint, the drafting sections in Regional Assessment Offices are being phased out. The assessment roll is the major source of a municipality's income and every effort should be made to streamline the assessment function. I am not convinced that OASYS will be that effective. Mississauga has generated over $15,000,000 in taxes since 1973 by appealing assessment. Our success is only as a result of having better information than the assessors.

I think that the Ministry of Natural Resources should be congratulated for its work in developing a conceptual design for a land-related information system and sponsoring these seminars. John Kerr and his staff have been extremely co-operative and helpful in carrying out the User Needs Study, answering our many questions and providing advice when asked. Without this leadership, I could see municipalities spending hundreds of dollars in developing independent land-related information systems that would end up lacking the required compatibility with other municipal and provincial data banks. Thank you very much. (Applause)

CHAIRMAN SCOTT: Thank you very much, Bob. I think there is probably some food for thought there and I will let you mull that over while we have some coffee. We are running a little bit behind. Maybe, I do not know whether it is possible to get out there and have a coffee and get back in 10 minutes or not, but if you can do that, please try. I will try to crank up

the speakers that come next and see if I can get them to talk a little faster, but we have got to play a little bit of catch up.

****** COFFEE BREAK ******

CHAIRMAN SCOTT: The next speaker that we have this morning is John Kerr, so again there is no duty as far as I am concerned in terms of introduction. John is going to talk to us about the Potential Applications for the Digital Topographic Maps that the Ministry of Natural Resources are producing. John.

POTENTIAL APPLICATIONS FOR DIGITAL TOPOGRAPHIC MAPS

JOHN H. KERR, Manager
Geographical Referencing Services
Ministry of Natural Resources

The User Needs Study recently completed by the Ministry of Natural Resources showed that, if properly structured, a digital topographic map would have more users, see more uses, provide more benefits, achieve more savings and be more versatile than the traditional paper map.

Digital topographic maps are in general required for resource and land use management as well as for a variety of planning activities. They are more versatile than their paper counterparts, in that:

- the map scale can be readily changed while line weights are simultaneously maintained,
- map features can be displayed on graphic screens for viewing, updating, overlaying, manipulating and windowing,
- feature symbols can be changed,
- maps can be drawn in minutes from a digital file using an automated plotting device, and contain only the features selected by the user, and
- the data can be transferred over a telephone line to remote offices.

Furthermore, the digital topographic map base can be used to create street network systems, which in turn can be used as a base for referencing accidents, crime occurrences, street names or street hardware such as traffic signs, street lights, traffic lights, etc. When structured topologically and linked to Statistics Canada files and other data, a digital street network provides opportunities for a variety of applications including time and distance districting, traffic and pedestrian flow simulation, optimal path selection, distance accumulation, spatial aggregation and choropleth mapping.

The User Needs Study also indicated there is a need for digital terrain models (DTM) or digital elevation models (DEM) as they are often called. Digital terrain models provide a 3-dimensional perspective of the earth's surface. It is intended to produce DTMs during the stereo-digitization of the Ontario Basic Maps included in the pilot projects mentioned earlier. Initially, DTMs will be produced mainly for the purpose of generating contours for these basic maps. They, however, have many other uses. For example, they are used in watershed and drainage basin analysis and in flood risk studies. They can be integrated with a variety of computer simulation models for different applications to automatically provide slope, aspect and sun intensity. Cross-sections and profiles can also be generated from them as can contours, breaklines and spot elevations.

Several specific applications that will benefit from the above digital products are as follows:

Ministry of Consumer and Commercial Relations

The Ministry of Consumer and Commercial Relations is responsible for the Province of Ontario Land Registration Improvement System Project (POLARIS), which is aimed at automating the land registration records in Ontario. This includes the creation of computerized maps showing the land ownership parcels. A digital Ontario Base Map can serve as a framework into which computerized parcel boundary files may be interactively adjusted.

Ministry of the Environment

The Ministry of the Environment has a variety of monitoring applications in which digital mapping could play an important role. For example, to display a video screen against a map background the location of the areas where the Ministry has issued permits to industry for taking water - the map background is needed to provide visual spatial correlation between the areas covered by permits and the geographic area in which they are located in order to ensure that too many permits are not issued against the same water source, thereby depleting the supply.

In addition, the Ministry of the Environment is interested in determining the UTM co-ordinates for water well locations. The wells are tied by measurement in the field to features such as roads and fences. The current procedure to determine the UTM co-ordinates of a well is to plot its location, relative to the features to which it is tied, on a map base and then to scale the co-ordinates of its position from the surrounding grid lines. If a digital map was available the field ties could be used to locate the well on a video screen relative to the displayed map features to which it was tied. Since the digital map features are defined by co-ordinates relative to the UTM grid, the co-ordinates of the well location would be calculated automatically and could be printed on the screen.

The Ministry of the Environment could also use video map display for the purpose of monitoring water samples to show the areas where water samples indicate pollution. By indicating the intensity of the pollution by darkening the shade of the water on the monitor display and by viewing the locations of such samples relative to each other and to a map background, one could view the intensity and extent of the pollution. Furthermore, if the data were viewed in a specific time sequence, the direction of spread would become evident which would assist in tracking down the sources of the pollution.

Ministry of Health

The Ministry of Health requires digital base maps and a digital street network system to assist in ambulance dispatch in order to reduce times

with respect to:

- identifying the geographic location from which a call comes,
- communicating the call location to the ambulance crew,
- determining the closest ambulance and the closest hospital to the call as well as the fastest route to take to both.

Additionally, these digital products will serve as a base upon which the Ministry could plan and develop capabilities for determining:

- optimal ambulance station location
- ambulance protocol
- dispatch algorithms
- standby vehicle locations
- service dispatch boundaries

A reduction in time taken to deliver patients to hospitals saves lives and averts suffering. The Ministry of Health estimates that one minute out of eight could be saved in the ambulance dispatch process through the use of digital mapping and related functions. It is a fact that the lives of many heart attack victims could have been saved if they had received medical attention a little sooner. In such situations a reduction of one minute could be the difference between life and death.

Ontario Hydro

Ontario Hydro is interested in digital topographic maps including digital terrain models to assist in computer-aided transmission line siting.

Ministry of Natural Resources

The Ministry of Natural Resources has several application areas for digital topographic maps and digital terrain models. The Aviation and Fire Management Centre requires both to help them fight forest fires and to select the best sites at which to place radio transmitters. Fires spread twice as fast up a 25 degree slope as they do on flat ground, thus it is important to know the lie of the land when fighting fires. By integrating a digital terrain model with the aviation and fire management centre's fire behaviour analysis and prediction system, fire behaviour could be better predicted. Using a digital topographic map as a base, a forest fire model can be simulated and displayed on a video screen.

Other parameters, such as wind direction, wind velocity, slope, soil moisture content, and fuel type can be entered into the model to provide a better prediction on the direction and speed of spread, so as to show quickly the areas to evacuate, and where to dispatch fire fighting crews.

The Forest Resources Group in the Ministry of Natural Resources is currently digitizing forest stand boundaries in order to better maintain the forest resource inventory and better manage the forests. In the

absence of a digital map base, Forest Resources must digitize the base map features of interest to them such as lakes, rivers, and roads. An available digital topographic data base would eliminate the need to digitize the base map features and ensure the features as presented on their maps are identical to those shown on the Ontario Basic Maps.

As more thematic users use the common digital base for displaying their data, it will simplify the exchange, overlay and comparison of data and pave the way for correlation studies such as determining the effect of certain soils, slopes and minerals on the growth of specific tree species.

Conservation authorities will use digital terrain models for drainage basin analysis and in flood prediction models. In time, when digital parcel maps are available, flood lines will be automatically generated and superimposed on digitized land ownership parcels so that parcels in the flood plain can be readily identified.

Public lands administrators use township plans to display the lands which have been alienated from the Crown. A new series of these plans called "G" Plans are being produced photo-mechanically using Ontario Basic Maps as the source for features such as lakes, rivers, roads, and township survey fabric. These new "G" Plans could be automatically derived from a digital topographic base, the lands alienated by the Crown could be added interactively using a graphics terminal which could also be used to update and edit the "G" Plans as required. Mining claims recorded in a regional office could be added to the files by the local mining recorder who would access the digital "G" Plan files from Queen's Park over the telephone lines. This would help to expedite the updating of the "G" Plans so that they would reflect a more current picture of the lands open for staking.

Outdoor recreation could "feed in" the recorded positions of rabies incidence by date and have them displayed on a digital map background on a graphics display tube. They could then monitor the extent and direction of spread of the disease in any part of the province which in turn would assist them in locating and destroying the animals that are spreading the disease.

The Ontario land inventory data is stored on paper maps where it is neither readily accessible nor usable by a variety of otherwise potential users. If this data was digitized and integrated with a digital topographic base, it would be used by many disciplines for a variety of applications, such as determining the number of cottage sites a given area will support or to provide the land use capability, timber use capability, wildlife use capability, and the recreation use capability for a variety of applications and studies.

Office of the Chief Election Officer

The Chief Election Officer has two fundamental requirements for digital maps:

- to produce quickly and confidentially electoral district maps,

- to measure the impact from changing electoral district and polling division boundaries with respect to the number of voters contained within any new districts or divisions formed. (Statistics Canada population data would have to be linked to the digital street network and digital topographic maps before this could be accomplished).

Ontario Provincial Police

The Ontario Provincial Police want a common province-wide digital map base against which they could plot the locations and times of crimes and traffic accidents. This would assist in the allocation of personnel as to place and time, and aid them in the suppression of crime while simultaneously reducing costs. In addition, a digital map base against which known criminal haunts could be plotted would assist in tracking criminals who had temporarily eluded police surveillance. (This latter application requires additional computer routines such as point-in-polygon search, which is easily accommodated in a digital map base).

Ministry of Revenue

The Ministry of Revenue is interested more in digital parcel maps than topographic ones. The digital parcel maps could be used for upgrading Revenue's assessment map base and to provide a video display of land ownership parcels and the associated attributes which affect assessment, such as lot dimensions, and the building, etc. contained within a specific parcel.

Municipalities

While there is a need for digital topographic maps in municipalities, it is relatively small compared to the need for digital land ownership parcel maps. This need was expressed over and over again in the four municipalities studied. The digital topographic map could, however, be used to produce a street network base, which together with the digital terrain model can be used for many municipal applications. Furthermore, the 1:2 000 digital OBM would provide an accurate framework for fitting digitized land ownership parcels to.

Utility Companies

Bell Canada, Union Gas, Trans Canada Pipelines and other utility companies have shown a great deal of interest over the past several years in digital topographic maps as well as digital parcel maps upon which each could overlay its plant.

The cost of developing these digital base maps on a province-wide basis is prohibitive for any single utility company. Cost is not the only obstacle. There is a need for almost all utility companies to correlate the position

of their own plant with the facilities of other utility companies, as well as with the horizontal control survey network and the property and street lines of the municipalities and regions in which their respective plants are located. Utility companies will use such digital base maps in maintaining their plant inventories as well as for updating their plant location records.

The DTMs are also of interest to utility companies particularly during the planning for installation stage.

There are other identified uses for digital topographic maps, DTMs and digital street network files and no doubt more will be identified as these products become available. As you heard earlier in the program, it is our intention to provide a digital topographic map base in several areas of the province within the next few years which can be used by any interested parties. (Applause)

CHAIRMAN SCOTT: Thank you very much, John. We are now going to take a look at another ministry within the provincial scene. The ministry that I am referring to is the Ministry of Municipal Affairs and Housing, and our speaker is Dennis Steen. Dennis is the Management Policy Advisor with that ministry. He has been a professional Accountant for about 30 years with a background in systems and computers and he works extensively with municipalities in areas of computer systems and applications and in the areas of research and development. Dennis. (Applause)

THE ROLE OF THE MINISTRY OF MUNICIPAL AFFAIRS AND HOUSING IN LAND-RELATED INFORMATION SYSTEMS

DENNIS F. STEEN, Management Policy Advisor
Municipal Administration Unit
Ministry of Municipal Affairs and Housing

Thank you. My topic is the role of the Ministry of Municipal Affairs and Housing and I have been asked by various people what on earth are we doing involved in land-related information systems, why would this Ministry be involved? I think some of them think maybe we want to rent a house there. One of the major reasons, I guess, is, if you look at my card, it says I am with the Municipal Information Section of the Municipal Management Policy Branch, and when we are talking about all of this stuff we are sure talking about information systems, and we are talking about policy making in municipal arenas, therefore, it is a logical place for us to have a role, e.g. sort of an official background.

I would have liked, by the way, to say a lot more today but I am not going to because we do not have a really official paper to present. I hope we will have shortly. But if you look at some of the background official material on the Ministry, you will find the overall role of the Ministry. It has responsibilities for local government, community planning, provincial land holdings and housing. It, amongst other things, offers management and administrative support along with financial assistance to municipalities. If you look farther down (by the way, you will find these statements in the government telephone directories amongst other things), you will find that the Assistant Deputy Minister of Community Planning has amongst his field of responsibility that of providing operational and technical assistance to encourage effective community planning and renewal activity in municipalities. And here again, we are very much involved in that, and you are and so is the geographic system.

If you look at the Assistant Deputy Minister of Municipal Affairs, that includes: to provide, amongst other things, a full range of advisory services to support local government and the promotion of the operation of local government. Within this you are looking at such things as the Planning Branch which is involved in the constant review of the planning, e.g. the Official Plan, which is the master plan of how you deliver services.

Geographic information once again, our own as I said, we are talking about information systems. If you look at a lot of the things that I have been involved in, they are dealing with municipalities, in the education, the advice, working with municipalities constantly, associations and so on to produce things that will improve the delivery of services via information systems.

We do research and development. Our publications include such things as using computers. Previously, John Sobura mentioned the Directory of

Computers and Applications in Municipalities. This is where it is at in the information system line.

We do a tremendous amount of work, at least I do personally anyway, with municipalities. We are very pleased to work closely with the Municipal Information Systems Association. In fact, at their October conference, those of you who were there would recall, we had one full day of parallel stream that dealt solely with this particular topic. And one of the interesting things that we bring to bear is instead of staying within the narrow confines of this project, we invite people like the City of Windsor who are doing something parallel with the intent to interface. We have, I think, a role in bringing people together who deal in this sort of thing and that is an important role.

We also try to keep in touch with people like URISA (Urban Regional Information Systems Association). I have connections with the Organization for Economic Co-operation and Development. They have an interest in this. Other provinces do also.

The applications. John has indicated some of those. We are concerned with what happens to the municipalities. We are perhaps concerned with and hope to advise in regard to municipalities - let us be on the leading edge of technology as opposed to the bleeding edge of technology. We have seen some rather sad things happen and we try to help bring that together. We will continue to have that interest, that role: we are not going to stop entirely. Just how much support we can give, I do not know. Certainly we have in the past developed programs to assist municipalities in this sort of thing. I think perhaps the most wellknown in the recent years was Municipal Action '85. I quote from the brochures there "That governments today are faced with increasingly complex challenge of providing the most effective management possible with the new economic realities. It is a challenge that is particularly strong at the municipal level where billions of dollars are spent every year providing essential services and where financial constraints are often most intense."

And we are saying within that program we are looking at increasing productivity, improving cost-effectiveness. We are finding staff expertise. And if you look at the management systems stream of that particular program you will see we are looking at complexities of decision making and financial control, advanced management and technologies. Innovative management systems have a potential to return the greatest financial benefits to your operation. I believe that is true. I believe this is one of those advanced innovative management technologies that has a tremendous amount of potential for all municipalities.

We are not ignoring the cost/benefit that has been mentioned before. Anybody who applies for any of our management systems grants has to perform a cost/benefit analysis. We are, though, very concerned that what is done is done appropriately, effectively, not just efficiently. Efficiency has been fine, it is doing the thing right; and effectively is doing the right thing. Because after all it is not much good to make the best buggy whip in the world if buggy whips are not in terribly big demand or are about to be.

We work very closely with systems people and, by the way, I think of systems as not the computer. I think of systems starting with you and me and ending with you and me, because if it does not do something for people, it is no system at all. So systems are the area, I think, that offer a lot in the future. The potential is there, people have already said that. I like to emphasize that and I think that is part of our role. We would like to feel that our own expertise in that area will add, contribute to the viability of systems that are developed. We have in my section developed the MARS data base, of which some of you are certainly aware, and that is an interministerial co-operative approach with large data base design. Jim Linders has talked to our Jim Stark about some of the aspects of that. I think we can contribute to the viability of what has been designed. We have a very wide experience with municipal applications and I think we may also be able to help program better. I recall Art Benjamin's "quotation" that flips up on the screen whenever he talks, that "if builders build buildings the way programmers design programs, the first woodpecker to come along would destroy civilization." So let us hope we can do a little better than that.

We look at the goals and we recognize something that we do have a very strong interest in our Ministry, that is the administration and financial control. Those systems continue to exist side by side with the other service delivery systems and they will continue to do so whatever is developed and the operational level must also recognize the importance of administration and control.

While we are trying to get to the goal way out there in the one area, let us not forget the goal in the other because that is part of our whole area of operation. That is one municipal corporation with one ultimate goal, although there are a lot of separate objectives. We do not like to see, we would hope we would not see, people building the tunnel from two different ends and winding up with two tunnels. That really is not the desirable goal. Whatever is built should fit together, and I personally encourage those things that have already been said in terms of co-operation, standards, working together, this cannot be emphasized strongly enough. It does not mean we should not be innovative, that we should always do things only the traditional way. And I have a particular personal experience on that. A few years ago I helped my cousin build his house with a swimming pool. We built the swimming pool first and that is kind of a strange way to operate. It was a concrete in-ground pool and we used the forms, the plywood forms that we needed to hold the concrete, as sub-floors in the house. You see he did have some sort of edifice and by golly, let me tell you when we were building that house proper it was great to jump into the pool that had been completed. So, really, you can be innovative, you do not always have to use a traditional approach as long as what you are doing makes sense and does work and eventually the thing comes together. That is the kind of thing, I think, that we can help to do a little bit.

I had a fair bit of other things noted down. I do not think I will go into any detail on them, because I was hoping that when our senior officials meet, and by the way they are meeting, they are discussing just exactly what the role of the Ministry is, we will be able to say something that is really official.

Like yourselves, all of you, we are faced with problems of constraints and too many demands on our limited resources. We would dearly love to be able to put in another project. Jim Stark, who is our Data Base Administrator, has also his degree in Cartography and Geography. What an ideal person, but unfortunately we are also in the process of tendering on the MARS data base and Jim is the Administrator and he will be tied up for Lord knows how long on that. I would like to do more personally myself, because I am very enthused about this project and have been ever since I heard about it, but I cannot. The demands on my time are extensive. I am behind on several projects. We have a major thing coming out, on micro-computers on municipalities. We are updating the Directory. We've got all kinds of things to do and again very few people to do this. But to the extent that we can and that our resources will permit us, we will certainly be working with and keeping in contact with John and the others on the project. It is important, I do not think there is any doubt of that. It is a question of just who we can assign, where, and how much we can kick in. We will continue anyway the role we had with advice to municipalities. We have been approached by several people already including some of the people in the pilot municipalities as to what we can do to support it. Advice and information is the least we can do, hopefully, we will be able to do a lot more. Unfortunately, I cannot really say more than that at this particular time. Thank you. (Applause)

CHAIRMAN SCOTT: Thank you very much, Dennis. I certainly hope that your Ministry can be part of the things that take place in the future, because certainly one of the things I think that should come out of the User Needs Study and the work that is going to be done is making everyone aware of the different resources that are available and helping to develop the mechanism so that those resources work together.

You have heard John talk about the Digitized Ontario Base Maps and we are going to give you an update to tell you where that program is, how much it has covered, what it hopes to cover in the future, and to do that for us from the Ministry of Natural Resources we have Cy Osborne. Cy graduated from the Institute of Engineering Technology in 1951, and from the Military College of Science in the U.K. in 1954. He became a professional engineer in 1960 and studied Public Policy, Evaluation and Analysis at the University of Toronto. Currently, Cy is General Manager, Mapping Services, Surveys and Mapping Branch, Ministry of Natural Resources. Cy.

ONTARIO BASIC MAPPING UPDATE

CYRIL T. OSBORNE, General Manager
Mapping Services, Surveys and Mapping Branch
Ministry of Natural Resources

The OBM medium-scale program is progressing steadily as you can see from this slide. This year's work was initiated in the Thunder Bay-Schreiber and Hearst-Cochrane blocks in Northern Ontario, and in the Owen Sound-Orillia block in the south. It was not possible to start the Windsor block, but this is scheduled for 1984 with the remaining blocks in Southern Ontario.

By the end of 1985 we will have established a good data base in Southern Ontario, and the southern part of Northern Ontario. We will then be in a position to produce medium-scale maps anywhere in this area on demand, subject of course to funds being available.

As far as large scale mapping of municipalities is concerned, this also is progressing steadily. Since we started, 320 municipalities have asked to be included in the program, and by the end of this fiscal year the mapping of 120 municipalities will have been completed or be in progress.

I suppose that you are waiting with bated breath for me to say something about digitization of OBM maps. (I am sure that the proceedings of the seminar will report that at this stage a deathly hush fell over the audience and the speaker!). The fact is that I cannot say when a continuous program for digitizing new OBM maps and those on the shelf will be started, since this depends largely on the success that is achieved in the next few years. All I can say is that it is uppermost in all our minds and when the optimum combination of technology, demand and funding exists, we shall start digitizing.

Finally, there is an index on the wall which shows in more detail the progress and priorities for the OBM program which you may wish to look at over the coffee break. Thank you very much. (Applause)

CHAIRMAN SCOTT: Thank you very much, Cy. I think it is certainly very interesting to be aware of the extent of work that has been done by the Ministry of Natural Resources and the volume of information that is available there.

John, in terms of our lunch, where is our buffet lunch? I did not ask before. Is it in the same room as last time? Anyway, we have really got two choices. Before I had said that it is essential that we hit that lunchroom at 12 o'clock, then we will probably have to take one of our next two speakers, either myself or Roy Audas, and move him on until this afternoon. If the lunchroom is able to survive if we arrive there at 12:30, then that is the second opportunity that is available to us. Does anyone here know how critical it is that we get there at 12 o'clock? John

is going to come back to tell us.

Well, I think rather than wait for John to report, I will give my paper on POLARIS and then we will make our decision at that time as to whether we can hang in for another half hour or whether we move one of the speakers until after lunch. Because certainly you are going to be interested, I think, in Roy Audas' paper in which he suggests some of the things that a municipality might do in order to prepare for the implementation of a land registration system.

I am going to have to move some of these things aside, so I hope I do not plunge the room into darkness as I do so.

POLARIS UPDATE

RAY SCOTT, Manager
POLARIS Project
Ministry of Consumer and Commercial Relations

The goal of the POLARIS Project, as no doubt most of you have heard before, is to implement improvements to the land registration system in the Province of Ontario. The improvements being developed range from changes in the legislation to automation and are shown in Figure 1.

A decision was made in 1981 to use the prototyping approach by implementing all improvements in a small test area.

The land registration area for the County of Oxford was chosen on the basis of selected criteria. The Township of Dereham and the Town of Tillsonburg constitutes the prototype area. All of the proposed improvements are to be implemented for the prototype area. The data on proposed boundaries and ownership for 6,000 properties were collected from the land registration office in Woodstock. Property index maps and the automated title files were prepared. The legislation required for the new system has not yet been passed and therefore the prototype has not been brought on stream to the public. It is currently being run in parallel by the land registration office staff. It is expected that the new legislation will become law before the new year allowing the prototype office to be opened to the public in early 1984. When that occurs people recording documents and plans and searching title for lands which lie in Dereham or Tillsonburg will use the new automated system.

The new system creates a separate record and a unique identifier for each property and provides a picture in the form of a property index map. The automated title file, however, does not necessarily contain all of the title information for the property. If the land is recorded under the Land Titles Act all title data will be in the automated file. All title data has been loaded for plans of subdivision which have been certified. For township lots all data from the time the last registered owner's search was performed to the present has been captured.

The data collection is now being undertaken for the adjacent Township of Norwich and the mapping is well under way. A 40-year abstract of title is being created for the properties in Norwich to allow a demonstration to be made of the systems future capabilities when all title data for all properties resides in the computer files.

The data collection team in Oxford County began their task by dividing the County into map blocks. The map blocks are delineated by transportation networks such as roads, railways, utility corridors and water boundaries to lend as much permanency as possible to their limits. Each map block is given a five-digit number. These numbers will be unique throughout the province.

IMPROVEMENTS PACKAGES LIST

1. Improved Legislation
2. Certification in the Registry System
3. Microfilming of Plans and Documents
4. Computerized Indices of Property Maps
5. Aggregate Information Reporting

Figure 1

When the search of land registration office records determined the number of properties within a block, a four-digit number was assigned to each property. These four-digit numbers are unique within a block and are assigned sequentially. The combination of the five-digit block number and the four-digit property number make up the unique property identifier which is assigned to each property. This unique identifier is the label under which information is stored in the automated title file. This unique identifier is also cross-referenced to more common identifiers such as owner's name, street address, instrument number and assessment number.

The data collection team also obtained copies of the Ministry of Revenue assessment maps covering Dereham and Tillsonburg. The assessment maps show properties, underlying fabric, assessment roll numbers and some dimensions.

They also obtained a computer print-out from Revenue which shows, for each property, the assessment number, owner's name, address and instrument number. This information from Revenue provides quick access to the information in our own files. The people collecting data look at the property on the assessment map, obtain the assessment number and using it, obtain the instrument number from the computer print-out.

Plans and documents are obtained for each property and bearings and distances are added to the assessment maps if required. This is not necessary for plans of subdivision or other recorded plans which already depict bearings and distances. The assessment maps are used as a vehicle to transfer information from the land registration office to computer files.

It is essential to provide a common frame of reference in order that information we are collecting can be used by other people. The common factor for land-related information is position and therefore the common frame of reference will be provided by the 6° UTM grid which appears on the property maps and the fact that the graphics system used to build the maps stores graphic elements in a location which is based on their UTM co-ordinates.

To derive co-ordinates for township lot corners, computer programs were developed to capture existing co-ordinate values and survey information from plans which connect these co-ordinated points. The resulting information can then be displayed on the screen of the interactive graphics station. This process provides co-ordinate values for some of the township lot corners and property corners.

Co-ordinates are derived for the remaining township lot corners by digitizing the township fabric from the 1:10 000 OBM maps compiled by the Ministry of Natural Resources. The digitized fabric can then be superimposed on the previously assembled control information. An editing process then occurs during which corners obtained from the digitization process are moved to more accurately located corners where these exist.

Lastly, information from plans recorded in the land registration system is added to further enhance our definition of township fabric in terms of both its size and its position on the earth's surface. The reference plans

recorded in our system are shown by dashed lines.

In the Township of Norwich a new approach is being developed to provide the required co-ordinates. This approach makes use of the MNR's MANOR program. For those of you not familiar with MANOR, it is a sophisticated computer program which makes possible least squares adjustments of large control networks. When we began to work in the Township of Norwich we worked within a large area bounded by highways and obtained the control information established by the Ministry of Transportation and Communications along these transportation corridors.

Computer programs were developed to facilitate the collection and analysis of information obtained from all recorded plans of survey within this area. The data is then transformed into a format acceptable to the MANOR program and least squares adjustments are done on a map block by map block basis. The sole purpose of the block by block adjustment is to obtain an analysis of the data in each block and to clean up the data as much as it is possible to do so.

It is possible to apply a weighting to any particular bit of survey data and the weighting applied depends on the reliability of the data. An examination of the residuals provided by the MANOR program provides an analysis of the network data and helps to both locate errors and assign weighting values. When the data is as clean as it is reasonable to make it, the entire area undergoes a least squares adjustment using the MANOR program.

This approach eliminates the problems encountered when adjusting one map block at a time. The problems I refer to are caused by the fact that a change in any map block may affect adjoining map blocks. This approach also provides indicators as to the accuracy of the resulting co-ordinates both in terms of their relative accuracy and their position on the earth's surface. This information is essential if other government ministries or agencies are going to use our digital data base in the future. Once the co-ordinate framework is complete the information on property boundaries, text and any information shown on recorded plans not previously entered must be added to the computer file.

This information, provided by the search of registry office records, and shown on the assessment maps, survey plans and documents, is entered either at the workstation using Intergraph I.G.D.S. software and computer programs developed by POLARIS staff or at the alphanumeric terminal using co-ordinate geometry programs.

Every effort is being made through the new approach just described, to develop the required co-ordinates and the use of co-ordinate geometry programs to capture interior plan fabric, to get as much data entry off the workstation as possible. In order to be efficient in terms of data capture and the disposition of resources, it is necessary to use the interactive graphics workstation for only the things it is most suited for - that is the decision making processes requiring interaction by the operator to solve problems, final editing and text placement.

When data entry is complete, the map surround, stored as a cell in the

computer files, is moved into position and the final information, such as map number, municipality, etc. is added. A check plot of each map sheet is then plotted. After the check plot has been checked and the design file corrected, a final plot of the map sheet on plastic material is prepared on a Calcomp 960 pen plotter. Each map sheet is microfilmed on 35 mm microfilm (which is placed in an aperture card) and a full-sized white print is made along with a 50% reduction. The original plot, full-sized white print, aperture card and 50% reduction are all sent to the Land Registration Office. The full-sized white print will be stored behind the public counter, and the 50% reduction will be stored in abstract-sized books on the public counter.

The registry office staff will manually update the full-sized white print and the 50% reduction when documents or plans are recorded which create new properties or amalgamate properties. The update may be as simple as drawing one red line on the map to show the new division line between properties, crossing out the old property identifier and adding two new identifiers. The plans and documents are also sent to the mapping centre to allow staff to update the computer file. When individual map sheets become cluttered with changes or large changes occur (such as the recording of a plan of subdivision) new map sheets will be plotted by the mapping centre. The public will be able to purchase Xerox copies of the 50% reductions which will be up-to-date property maps. They will also be able to purchase copies of the full-sized maps but these will be made from the original plot and will only be up-to-date at the time they were plotted. Copies of the block index maps which show block numbers and microfilm copies of maps will also be available for sale.

When the new automated system is in operation, an individual wishing to search the title for a particular property can go to the block index map (which will be on the wall in the registry office), get the block number (which is also the map sheet number), obtain the property index map and determine the unique identifier for the property. The unique identifier can then be entered into a terminal in the registry office to access the title file. As mentioned before, the unique identifier will be cross-referenced to more common identifiers such as owner's name, address, instrument number and assessment number.

The work now being undertaken by the POLARIS staff, besides the mapping of the next municipality, consists of development and investigative work to:

- make the data gathering and data entry processes more efficient;
- provide geographical searching capabilities;
- investigate the automatic maintenance of adjacency relationships;
- investigate the storage of non-graphical data in the graphics data base;
- investigate sharing of data with other agencies; and
- develop routines for providing customized map products.

Customized maps have already been prepared in one instance for the planning department of the County of Oxford to illustrate the area covered by a by-law around the airport in Dereham. The provision of this information

saved the planning department from the onerous task of searching for information in 40 to 50 township lots and also greatly reduced the time that would have been spent drafting maps.

When the mapping is completed for any given area, this Ministry will have spent a considerable amount of money gathering all of the information shown on plans and documents recorded in the registry system. This data could be provided to municipalities in various forms:

- if a municipality has a compatible workstation, it could be linked to our computer and we could share the information in the design files;
- if a municipality has a compatible system, we could put our design files on tape and provide the tape to the municipality;
- if a municipality has equipment which is not compatible with ours, we could still provide our information on tape in Standard Interchange format;
- MCCR could provide a file of co-ordinates for sub-division fabric and property corners; or
- we could provide paper maps to the municipality at any scale required showing any combinations of information we have in our design files.

In a municipality the information required to conduct the day-to-day business is related, for the most part, to either streets or properties. Various files of information will reside in several municipal departments. The data in any particular department must be formatted so that it will serve the needs of all departments. It should only be collected once and should only be updated once. The municipal data system (be it automated or non-automated) must allow departments to exchange data. The co-ordinates of property corners and subdivision lot corners would be one more file of information in this municipal information system and it is hoped that the POLARIS mapping program could provide this co-ordinate file.

However, it may be essential for a municipality to move ahead and create the file of information on property boundaries on their own rather than wait until the POLARIS mapping is in place. If this property boundary file is created by the municipality in an automated form, it is essential that the municipality and the provincial government work together to assure that the work is undertaken in a manner that the resulting data fulfills the needs of the municipality and is usable by the POLARIS mapping program.

Much thought and discussion has centred around the need for accuracy when information about property boundaries and sub- division fabric is gathered. Ontario Land Surveyors are often accused of pursuing accuracy as if it were the holy grail, while systems analysts who become immersed in developing and implementing a system which gathers and uses survey data and have to wrestle with all the problems inherent in that body of information may regard accuracy akin to leprosy. The truth, I think, lies somewhere in between. In determining the accuracy you need to achieve in your data base, regard must be had for the following:

- When we talk about accuracy we must realize that the term is applied to two different things. First, there is the

accuracy of the location of points on the earth's surface (referred to as absolute accuracy). The accuracy attainable in this area depends on the survey control network which exists and the ties between control stations and property corners which have been established on the ground.

Secondly, there is the accuracy of the distances and angles between property corners (referred to as the relative accuracy). The accuracy obtainable in this instance depends on the correctness of the property definitions you have to work with and the manner in which you capture this information in the computer. I suspect that relative accuracy is more important to a municipality than absolute accuracy.

- Can you foresee all of the demands that will be placed on your system once people have become accustomed to it and realize its potential? The greater the accuracy of the data in your system, the more of these demands you will be able to satisfy without redoing your data entry. I suspect that many municipal departments will ask more and more of an automated system once they have worked with it over a period of time.

- What are the resources available to gather the data? Resources will most certainly be limited. Straight blind digitizing of existing paper maps is the least expensive approach but will provide only an index map, a picture of properties in their proper relationship. You can, of course, assign identifiers. This approach provides a digital file which is at the low end of the scale in terms of both absolute and relative accuracy but at least it allows you to provide a graphic component to your information system.

- Another approach is to digitize maps but at the same time enter into the computer additional information such as information which allows the computer to be aware of what lines are property lines as opposed to others which are subdivision lot lines, etc. This approach can become quite sophisticated and certainly adds to the cost. It is essential to be aware that if you do not have a good set of maps which you can digitize but are reduced to digitize individual maps and plans from many sources and trying to fit this information together, the costs can increase rapidly. The absolute and relative accuracy resulting from the second approach are no better than with the first method.

- A third approach is to relate the maps you are digitizing to a geodetic control network. The absolute and relative accuracies are both improved and the increase in costs depends on how many points are tied to control.

- Yet another approach is to enter bearings and distances, wherever they are available through the keyboard. You also have the option of tying this information to control networks and providing absolute accuracy in your data base.

- Approaches to data collection which involve entering bearings and distances from plans and title documents also involve searches in the Land Registration Office to acquire this information and this again will add to the cost.

The point that I am trying to make is that there are a range of options open to you when you decide how you will structure your data and what method you will use to capture it. It is interesting to note that the City of North York and Metropolitan Toronto are both involved in programs which capture bearings and distances from existing plans of subdivision.

It certainly makes no sense if a municipality spends large sums of money capturing subdivision and/or property data by digitizing and a short time later the Ministry of Consumer and Commercial Relations captures the same data all over again by entering bearings and distances through the keyboard. I hope that we will be able to develop approaches to data collection which will satisfy both our needs. Thank you. (Applause)

Our last speaker before lunch is from the Ministry of Natural Resources, Roy Audas. He is going to talk about some of the things that a municipality might do to prepare itself for the implementation of a land-related information system. Roy received his topographical survey training in the Canadian Armed Forces and currently he is Supervisor of Activity Programming and Control for the Ontario Basic Mapping Program of the Ministry of Natural Resources. Roy. (Applause)

IN PREPARATION FOR THE IMPLEMENTATION OF A LAND-RELATED INFORMATION SYSTEM

ROY AUDAS, Supervisor
Activity Programming and Control
Ministry of Natural Resources

Thank you very much, Ray. Good morning ladies and gentlemen. I find that most everything that I am going to say has already been said before. So it should not take too long to repeat it. I apologize for that, but what I would like to do is present it in the context of an action plan for a municipality. A lot of municipalities are interested in getting into this field and over the past day and a half you have heard of the activities that are going on within the Ministry, as far as the User Needs Study is concerned.

The next question is, as a municipality what can I do? We also heard that there are some municipalities who are seriously considering getting into the game and really do not want to wait for the pilot projects to be completed, and we can understand that urgency. We would only ask that those municipalities, as Mr. Johnston said, would maintain close contact with the Management Committee of the pilot projects so that any problems that they run into, and the problems that we identify during the pilot projects, could be solved to our mutual benefit.

Although we are only in the planning stage of the pilot projects and though no such systems as described by Jack Dangermond and Jim Linders exist in Ontario today, the steps that we have identified can be of value to a municipality whether they in fact achieve a computer-oriented land-related information system or whether they maintain their conventional hardcopy maps and files.

And the first step in that action should be the establishment of a committee or task force. Most municipalities in conjunction with MISA have some sort of data processing steering committees and a task force or subcommittee of those committees could, in fact, be organized to get into the land-related information component. One of the first requirements of that task force would be to describe in general terms the requirements of your municipality as far as land-related information is concerned. This would be general at first, but through a user needs study in your own municipality, could be defined in more specific terms. In the City of Burnaby, B.C., Mr. Miller mentioned yesterday that they got into this game about mid 1975, mainly for the purpose of updating and reformatting existing mapping. They completed a user needs study in March of 1983. That study was conducted to increase the use of their digital topographic data base. It was conducted by one individual over a period of eighteen months. The report consists of three volumes and goes to the degree of detailing engineering requirements for capital works structures such as grade separations and culverts, etc. Obviously, at this stage of the game and completing that kind of detailed user needs study, it would be very

difficult to separate "the wheat from the chaff", and I would recommend that a process much similar to what the Ministry has achieved be conducted in the municipalities. Documentation of that study and the studies carried out in the municipalities, as John said, would be available to you as a guidance.

In particular, it is important to identify the specific users and document the flow of the information you are now using. This should also, as was mentioned before, include local utility companies and their involvement in the user needs study would be of mutual benefit. Both from the information point of view and hopefully as you get into implementation, in a financial point of view.

Based on the information you obtained from your own user needs study you would then develop your own conceptual models and again the information made available from the Ministry is a guideline, but by no means can we say that is in fact the way it should go, because again we have not put any of those systems in place. And the information that you would generate would identify different groups of different types of information and they together would make up your whole information system.

The next step would be looking towards arranging those files into the information groups which we have identified to some extent as a property data base, street network, engineering data base, topographical data base. Each one of those data bases could, in fact, be initiated independently. The common denominator between the data bases will be the UTM system, the co-ordinate system for information. It will be up to you to decide which data bases' specific type of information will be recorded in. There was indication yesterday that even with the experts there is some disagreement as to in which data base certain items should be stored, for instance, some municipalities in conventional terms are capturing sidewalk information, and street information on a topographic data base. When you get into a computer based land-related information system, should that be shifted to an engineering data base, should it be included in the street network? The street network could be used as an index file to existing hardcopy engineering drawings or you could, in fact, initiate a complete independent engineering data base.

The data bases themselves as you initiate them using the UTM system, might be of different degrees of accuracy and in the initial stages you might have some difficulty overlaying the property data base with the street network or the topographic data base. In fact, depending on how you organize and structure your data, you might not even need to overlay those two graphic products, but as you increase the accuracy as you tie property corners into the horizontal control network as you upgrade the information it becomes more feasible in the long run to amalgamate all of that type of information. In the end, and many years down the road, you will have a complete compatible land-related information system.

Some of the considerations that go into the development of the data bases are, for example:

(1) Whether they would be linked, hard wired or through tape transfer.

Again, Mr. Miller alluded yesterday to the fact that Calgary being a large system, transfer of information between the separate data bases is by tape transfer. There is no direct hard wire contact between each individual data base.

(2) Who will be responsible for the maintenance and update of each data base?

Again it might be a consideration of restructuring somewhat the mandates of the various departments within the municipality.

(3) Should there be a central agency who is responsible for capturing that data and making that data available to the engineering planning departments or should, in fact, one of those departments be made responsible for the maintenance and update?

Again that is an individual municipal requirement. Each one would have their own reasons for the various ways they would lay down these responsibilities.

(4) What is the accuracy requirement for parcel data?

This has been a topic that has been discussed many times, yesterday and today, and hopefully in Mr. Linders' paper, after lunch, we will come down to some hard facts and some hard decisions what you should do in those regards.

(5) Where will the street network information come from?

This can be generated from large scale 1:2 000 maps if you have them in existence. They could be generated from 1:10 000 or 1:20 000 medium scale maps produced by the Ontario Basic Mapping. They could be generated from existing NTS maps; or in fact as one municipality has recently done, they could be generated by photogrammetrically capturing the information of new aerial photography.

(6) For municipalities over 50,000 population what arrangements do we need to get access to Statistics Canada information files?

OBM Mapping contains the geo-referencing data (that is the control and map detail) that you are going to need. If you have not applied for this program, I would recommend you do so. As Mr. Osborne mentioned, there are a number of municipalities that have been completed to date. If you already have existing 1:2 000 mapping or any type of organized mapping program in the municipality, that mapping program might not have been originated from a very good controlled monumented horizontal control network. Again you should analyse the existing control network you have, ensure that it is compatible with the Ministry of Natural Resources COSINE Program, and in fact have it installed in the provincial data bank. That is to your advantage in the long run come redefinition and it is in the Ministry of Natural Resources benefit to get as much of the controlled

network in existence out there into their data bank.

Ray Scott has just mentioned the POLARIS project. The block numbers that he has mentioned, if you are going to digitize your own property maps, you can obtain those block numbers from Ray's organization and you can generate the property identifiers for your individual properties as you capture the information and this then will be compatible with their system in the long run.

Finally, you need to develop a municipal address system and arrange to maintain it and to ensure that each property in the municipality will have a unique address.

Ambiguous street names should be avoided. Developers tend to make their subdivisions attractive by using interesting names; in the case of Calgary they identified, the GRS people were having a real headache with one subdivision where in a kind of condominium set-up the developer had used the same first name and just changed the last designation to a place, road, circle, for instance, Cherrywood Place, Cherrywood Lane. Within one neighbourhood this can really generate headaches, both for the information system and for emergency response teams.

Some other important considerations:

At some stage in the exercise, the task force should make presentation to council to gain much needed political support and to secure a financial commitment. This could follow the completion of your conceptual model but not before you really have a good feel for the direction that you intend to take.

Implementation should be designed to achieve results soon and a continuing dialogue should be maintained with users of the system. It is important to keep them in the picture, encourage comments at any time during the development stage.

One of the main things to success of any implementation of a land-related information system will be the acceptability by the users of that system and the ease of use by the individuals.

Finally, I just would like to add a personal note. It seems that we are in for some exciting times within the next two to three years and I personally would be very excited to be part of it. Thank you very much. (Applause)

CHAIRMAN SCOTT: Thank you very much, Roy. Well, we did not do too badly. We are only fifteen minutes after the hour. So I hope also that Roy's comments will generate some comments from you. I saw quite a few hands going up and I hope we will get that feedback after lunch. And if we can try to be back here by 1:15, that would be nice so that we can get on with the afternoon activities. So let us take a lunch break.

AFTERNOON SESSION TUESDAY, DECEMBER 13, 1983

CHAIRMAN SCOTT: Let us get ourselves under way for this afternoon. I think we managed to get you involved to some extent this morning and we hope this afternoon we can do that even more so. We proposed discussion groups and we will get to the arrangement of those a little later on.

I noticed yesterday that everybody was very formal out there. You got on a nice suit of clothes. You all look great guys, you got nice threads. We really think you dress well, but after that nice lunch that you had, if you want to take off your jackets, roll up your sleeves, loosen your tie or even undo your shoes that is okay. Anything that will help you get involved and get in here and start to talk to us, we will appreciate that.

We are going to start off this afternoon with Jim Linders. Jim is going to talk a little bit about the questionnaire that they had sent out and he is going to talk a little bit about accuracy and precision. Not necessarily just accuracy. Jim. (Applause)

DIGITAL PARCEL MAPS - ACCURACY VERSUS COST

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ABSTRACT

An essential component of a municipal information system is a systematic, comprehensive parcel inventory which provides the framework for much of a municipality's information base. Traditionally, such systems have been manual in nature but there is now an increased interest in building digital parcel data bases with an emphasis on the quality of the associated data. A basic consideration in the development of such parcel systems is the notion that the parcel base must provide comprehensive information coverage as well as a high degree of accuracy. This paper discusses some of the basic notions which underlie the development of digital parcel data bases. This is combined with information obtained by the user questionnaire as to the requirements for a parcel base in digital format.

INTRODUCTION

There are a variety of approaches to the development of parcel based systems, each of which is distinguished by a unique set of characteristics. Traditionally, a parcel base system is represented in terms of parcel map graphics, such as a registered plan of subdivision or an index plan. Each parcel is unique in its spatial representation, namely in its position and its relationship to other parcels. Normally, the parcels are shown in relationship to the street network which in turn can be related to the horizontal control network.

Parcel systems are usually established for specific purposes. A parcel base map shows the lot fabric, usually in conjunction with the street network. There are various levels of geometric accuracy associated with the parcel graphic. Since a registered plan of subdivision is geometrically consistent, it is possible to have an exact scale representation of the lot fabric in terms of an associated graphic. Less accurate graphics provide schematic representation of the lot fabric with limited geometric correlation to the ground. A cadastral system enhances the lot fabric with ownership data as well as a variety of attribute information.

MUNICIPAL NEEDS STUDY QUESTIONNAIRE

In carrying out the user needs study for municipalities, a questionnaire was sent to all municipalities of a size greater than 20,000. The questionnaire was designed to provide greater insight into the information needs for a parcel data base and was multi-purpose in nature. Firstly, it

seemed expedient to validate some of the findings of the Municipal User Needs Study. The evidence collected from the four study areas was such that in order to be statistically meaningful it was deemed appropriate to extend the study by means of a questionnaire to all other municipalities who are involved with the creation and maintenance of parcel based systems. Secondly, in working with the municipalities, it was found that certain information concerning the parcel fabric emerged only as the study progressed. Hence, greater insight was needed to provide a fuller picture.

Therefore, it was appropriate to use the questionnaire as a means to extend the scope of the existing study with further user oriented data. A major outcome of the User Needs Study was the perceived role of accuracy in the creation of parcel maps. Consequently, it was necessary to validate this finding by correlating it with a wider community of users.

Lastly, it was deemed appropriate to establish a rapport with other municipalities who were dealing with land-related information.

The questionaire as distributed is shown in Appendix 1. Approximately 59 municipalities responded to the questionnaire in time for the presentation at the seminar. Of this number, 46 municipalities had indicated that they currently had land parcel maps. Of these, two were produced from digital files, one was produced from a combination of manual and digital files with the remainder being produced manually. Twenty-one respondents indicated that the current parcel maps were sufficiently accurate for all known users. Twenty-three indicated that accuracy needs were not met.

Question 4 on the questionnaire required some indication of the map scales in use. A wide variety of map scales were reported as follows:

TABLE 1

Map Scales Reported

Map Scales Reported	Number Reporting	Percentage of Total Response
1" = 40'	1	1.7
1" = 100' (1:1 200)	10	17
1" = 200' (1:2 400)	13	22.4
1:500	2	3.4
1:1 000	3	5.1
1:1 250	3	5.1
1:2 000	12	20.3
1:2 500	1	1.7
1:5 000	1	1.7
Varies	5	8.6
1:3 500	1	1.7
1:10 000	1	1.7
1:15 840	1	1.7

CONCEPT PAPER

Background

The Ministry of Natural Resources was given the responsibility in 1974 to develop a comprehensive system which permits the rapid and visual geographic correlation of the physical properties, legal status, resources and use of the land in Ontario.

To date several standards and components of the comprehensive system are in place, others are under development. We are aware of several components that we have not yet started to work on and no doubt there are some that we simply, as yet, know nothing about.

In place are such things as provincial horizontal control survey standards and guidelines, the provincial horizontal control survey data bank, a horizontal control survey adjustment, analyses and network design program, a program for plotting control survey networks and a program for converting co-ordinate values from one system to another.

The Universal Transverse Mercator Grid System has been adopted as the official provincial geographical referencing grid. A systematic series of grid cells structured on the UTM has been defined for those who reference their data by cells. A point location identifier in UTM format is also in place.

The Ontario Basic Mapping system is yet another fundamental component of the comprehensive system. The mapping program is well under way and total provincial coverage is expected by the mid-1990s. These standards and components of the comprehensive system are being developed and promoted to help everyone in this province who deals with land-related information. If adopted and used, many of the correlation problems will disappear and data will be much more available and useable than it would be otherwise.

Maps are fundamental to almost all land-related information systems. Some information systems in fact are structured on digital maps. The Ministry has been aware of the growing use of digital maps in North America and has kept abreast of the capabilities of the more promising systems. We have even developed a pilot system to determine first-hand what can and cannot be done with this technology. We are to some extent aware of the strength and weaknesses of these systems for several provincial applications, but we know little about their capability to meet municipal needs.

At a Geographical Referencing Seminar sponsored jointly by the Ministry of Natural Resources and the Interministerial Committee on Geographical Referencing held at Queen's Park last year, it was recommended that the Ministry play a role in identifying a generic land-related information system which municipalities could use. We agreed to get involved because of the apparent need to ensure some degree of compatibility in these systems as they evolve across Ontario. In order to determine what such a system is required to do we have to know what the potential users want. We are therefore embarking on a user needs study early next year. The scope of the study was intended to cover the sixty or so geographical referencing systems in the provincial government and a good cross-section of municipalities.

Unfortunately in light of the present economic conditions and fiscal constraints we will not have the financial resources originally hoped for and therefore must focus our attention on considerably fewer municipalities than originally intended. An in-depth study will, however, be made of three provincial municipalities: one with a population over 500,000, one with a population between 75,000 and 500,000 and one with a population under 75,000.

This will be followed by the preparation of a functional specification outlining what has to be done and then a feasibility study to determine how best to meet those needs.

From this initial phase we will develop a conceptual design for a land-related information system for your municipality including how the system relates to digital Ontario Basic maps, POLARIS and other provincial systems which are of interest to you.

To assist us in determining which three municipalities should be studied we are distributing the attached response form to all municipalities in Ontario with populations of over 20,000. We want your municipality to indicate its level of interest and what cooperation and participation it is prepared to render if it is chosen for the study. We expect your proposals to be returned to the Surveyor General's office, Room 6602 Whitney Block, Queen's Park, Toronto(M7A 1W3) by February 1st, 1983, at which time they will be reviewed and three municipalities selected for the study. The selection will be based on what is felt to be the best alternatives for ensuring the funds we have available will effectively complete the user needs study, permit the preparation of a functional specification and complete the feasibility study which includes a review of the capabilities of any candidate systems.

The meeting will bring in expertise to perform or help in performing the initial conceptual analysis of your municipal operations including how Ontario Basic Mapping relates to your data. We will also look at other aspects of the geographic data linkages, data base networks for positionally related data, thematic mapping, your land records and the kinds of problems for which people seek answers from these records.

We will assist you in looking at the overall picture and in coming up with some conceptual solutions.

Through this study we expect in addition to the things already mentioned to determine what role digital Ontario Basic maps are expected to play in both provincial and municipal information systems. We will also identify which if any existing system appears to most closely meet the user needs.

MUNICIPALITY RESPONSE

MUNICIPALITY: _____ Population _____

Address: _____ Telephone _____

_____ Postal Code _____

_____

Number of Departments _____

CONTACT: _____ Telephone _____

Department: _____

Address: _____

_____

_____ Postal Code _____

		YES	NO	DON'T KNOW
1.	Currently have Digital Mapping Facility	___	___	___
2.	Currently have computerized alpha/numeric land-related information system.	___	___	___
3.	Prefer municipal and provincial land-related information systems be compatible.	___	___	___
4.	Currently have a committee of representatives from different departments of your municipality who have been studying how to implement a LRIS and who could serve as liaison group between municipality and MNR staff and consultants performing a user needs study.	___	___	___
5.	Could provide two people to work with MNR staff and consultants in carrying out the User Needs Study	___	___	___
6.	Could provide one person to work with MNR staff and consultants in carrying out the User Needs Study.	___	___	___
7.	Could not spare anyone to work directly with MNR staff and consultants on a user needs study, but will provide a contact person who will direct MNR staff and consultants on who to talk to and schedule appoint-ments.	___	___	___

	YES	NO	DON'T KNOW
8. Cannot provide staff to assist MNR staff or consultants with a user needs study but are interested in having such a study made in our municipality.	___	___	___
9. If a system was available which demonstrated a significant benefit/cost saving would you be prepared to implement it?	___	___	___
10. Are you interested in a document which would outline those things that a municipality should do in preparation for the implementation of a Land-related Information System?	___	___	___
11. Is the 1:2000 scale Ontario Basic map in digital form relevant in meeting some of your requirements?	___	___	___

If yes, identify potential application areas:

12. Would you share the cost of a user needs study for your municipality on a 50/50 basis with the Ministry of Natural Resources? ___ ___ ___

13. In addition to any resources stated above we are prepared to do the following, if our municipality is chosen for a user needs study: (Use overleaf if necessary.)

14. The qualifications of the staff we are prepared to provide to assist in the study are:

The information shown on parcel maps varied rather extensively. The following table (Table 2) indicates which information reported is shown on these maps as well as the relative percentages. In order to have a better understanding of the importance of each item, it would be necessary to conduct further and more comprehensive investigations. Obviously, many of the parcel maps are customized to the needs of specific municipalities.

TABLE 2

Information Shown on Land Parcel Maps

	Number of Entries	Percentage of Total Responses
Parcel Boundaries	45	76.27
Parcel Dimensions	21	38.89
Parcel Boundary Bearings	7	11.86
Street Address	24	40.68
Parcel Identifier	21	35.59
Curbs	9	15.25
Street Lights	7	11.86
Fire Hydrants	7	11.86
Street Signs	4	6.78
Zoning Boundaries	37	62.71
Pole Lines	19	32.20
Utilities	6	10.17

Other Data

Registry Office Instrument Numbers
Right of Way
Location of Buildings
Lot and Registered Plan Numbers
Assessment Numbers
Topographical Detail
Land Uses - Severances and Zoning
Flood Elevations
Reference Plan Data
Lot Dimensions
Spot Elevations

Question 5 was an attempt to ascertain the source data used in the production of parcel maps. Table 3 identifies the various sources of information including registered plans of subdivision, assessment maps, Ontario Basic Maps, etc. as well as a variety of other sources including metes and bounds descriptions, railway surveys, field surveys, deeds and legal descriptions, boundary act surveys, etc. It was difficult from the current questionnaire to ascertain the degree to which each of the above apply.

TABLE 3

Source Data Used to Produce Parcel Maps

	Number of Entries	Percentage of Total Responses
Registered Plans of Sub-division and other Surveys	39	66.10
Assessment Maps	33	55.93
Ontario Basic Maps	1	1.69
Topographic Maps other than OBM	17	28.81
Aerial Photographs	26	44.07
Horizontal Control Survey Data	9	15.25

Other Sources

Metes and Bounds Descriptions
Railway Surveys
Field Surveys
Deeds and Legal Descriptions
Boundary Act Surveys
Title and Severances
Co-ordinate Geometry (COGO)

An attempt was made to ascertain the department, section or unit responsible for the maintenance of the land parcel maps. This was Question 6 of the questionnaire. Table 4 is the listing of the various organizational entities which performed this task. It is interesting to note that the Planning Department was by far the largest entry in this Table followed closely by Public Works and Engineering. In almost every municipality, the Planning Department seemed to have a major interest in the maintenance of land parcel maps.

TABLE 4

Department, Section or Unit Responsible for

Maintenance of Land Parcel Maps

	Number of Entries
Planning	16
Public Works	8
Engineering	5
Regional Assessment Office	4
Project Mapping	1
Engineering and Public Works	1
Engineering and Planning	3
Planning and Development	3
Planning, Engineering and Clerks	1
Surveys and Mapping	2
Surveys and Mapping, Property and Planning	1

The individual uses of the parcel maps are identified in Table 5. Again, it would be informative to establish a correlation between the agencies responsible for the production and maintenance of parcel maps as well as their use and required accuracy.

TABLE 5
Uses of Land Parcel Maps

Development Analysis
Real Estate
Official Plan Designation
Maintenace of Services
Identifying Property Owners and Lot Dimensions
Site Plan Review
Assessment
Public Transit Planning
General Information
Location of Complaints
Design (Capital Works)
Industrial Records Data Base
Surveying
Property Purchase and Sales
Cross-referencing to other Maps
Index to Computerized Planning and Topographical Data Base
Research and Development

The primary interest in conducting the study was to ascertain the perceived needs for parcel maps as well as their associated accuracy requirements. Table 6 is an indication of the replies as found from Question 7 in the questionnaire. The predominant use of parcel maps seems to be as a visual index of parcels followed closely by overlaying of administrative boundaries as a secondary function for these land parcel maps. There are obviously a number of other important uses as identified in the Table including socio-demographic data, presentations and board hearings, reports, planning studies, etc. It is interesting to note that the uses of the data range over a wide variety of administrative units within a municipality.

TABLE 6

Major Use of Land Parcel Maps by a Muncipality

	Number of Entries
Visual Index of Parcels	37
Overlaying Administrative Boundaries	11
Others:	
Displaying Socio Demographic Data	
Presentations and Board Hearings	
Accompanying Reports	
Planning Studies	
Development Control	
Land Severances	
Land Use Planning	
Zoning By-Law Preparation	
Zoning By-Law Notification	
Street Numbers (Municipal Addressing)	
Subdivision Development	
Engineering	
Fire	
Police	
Redevelopment	
Storm Sewers, Easements, Sidewalk Location	
Construction Plans	

During the interviews with the four municipalities involved in the study it became abundantly clear that the need for a highly accurate parcel map was not a primary requirement. Consequently, Question 8 was designed to solicit supplementary input from a broader base of municipalities. An indication of those requirements for ground accuracy of greater than 2 metres was asked for in Question 8. Table 7 is a listing of the purposes identified by municipalities and their response to the questionnaire.

TABLE 7

Uses/Users Requiring Ground Accuracy Greater than 2 Metres

Construction Drawings, Engineering Design
Buildings (Capital Works)
Land Surveys, Cadastral Surveys
Real Estate, Property Purchase
Land Division Committee
Committee of Adjustment
New Development
Municipal Departments - Industrial Developers, Taxation
Public
Location and Maintenance of Services and Utilities as-built Drawings
Computer Graphics
Local Improvements

Question 9 was an attempt to identify the utility of digital information associated with land parcels. Of the respondents reporting, 29 indicated that there was an increase utilization of the information, while 11 indicated no increase, and 2 were uncertain. This is related, to a degree, to the level of automation and computer capability associated with the individual municipalities. An attempt should be made to correlate the increased utility with the type of municipality and the associated information system available to them.

Question 10 dealt with the availability of land parcel based information systems. In the responses, 23 municipalities reported that such was currently in place, of which 15 were manually based and 7 were digital, with 1 being both manual and digital. Fifteen municipalities indicated that there was no land parcel base information system in place within their municipality.

The final question was used to ascertain the ground positional accuracy requirements for utility and service mapping. This was inserted primarily because many of the municipalities contacted had indicated that the requirement for accuracy stems primarily from utility and service mapping purposes. Of those reporting, it is interesting to note in Table 8 that only 11 respondents indicated that requirement of better than 15 cm was necessary, with the majority in the range of 15 cm to 50 cm. In retrospect, these answers can only be seen as meaningful if there is a firm understanding of the notion of accuracy which is common across all users. This is dealt with in the latter part of the paper.

TABLE 8

Requirements for Accurate Parcel Maps

Planning Studies
Public Transit
Development Analysis
Delineating Certain Lines of Natural Environment
Municipal Departments - Industrial
Fire
Polic
Parks, Recreation
Lawyers

General Comments of Questionnaire

From the results of the questionnaire, a number of conclusions can be drawn. First, the results are not necessarily conclusive. It is clear that more information is needed to more fully explain the results. As well, perhaps a better understanding of the information base is needed between both the user community and the discipline. It is apparent that more dialogue is needed to better understand the environment and to assist in defining the associated problems. The basis of the questionnaire was to begin such a dialogue and to promote a better understanding between the municipalities and the government agencies involved with parcel mapping.

From conducting the study and from the results of the questionnaire, it was quite clear that there is a need for general guidelines and directions to municipalities and industry for the development and creation of parcel data bases. Failure to do this will lead to a variety of application programs and approaches which will not be conducive to a common perspective of land parcel data bases for the Province.

The questionnaire appeared to be based on a limited perspective for many respondents since they have not had much exposure to this type of environment.

The results of the questionnaire indicated that there was a general appreciation of the needs for maintenance and utilization of spatial information. Associated with this was the notion of accuracy requirements. In most cases respondents were making do with the best that was available as opposed to what might be desirable.

For the study team, the questionnaire did provide a greater insight into the needs of users and uses as well as the potential for a parcel system within the municipality. Information derived from the study was most meaningful in developing the associated models for municipalities and the municipal provincial interface.

Parcel System Accuracy

There is a potential for confusion when discussing accuracy within the context of parcel systems. There are at least 2 aspects of accuracy which must be considered, namely positional accuracy and recording accuracy. Each is unique and can be quantified and as such each has implicit consequences on the overall parcel base system.

Absolute positional accuracy relates to the location of parcel corners on the earth's surface with respect to an earth based referencing system. Since the earth is a spheroid, the conventional referencing system used is a spherical co-ordinate system in which we understand position to be expressed in terms of angular distances of longitude and latitude from central meridians. For large scale applications, the use of projection systems provides approximations which are acceptable for measurement of Cartesian distances on the earth's surface. Hence, for most of Canada, and in particular Ontario, the 6^{o} UTM projection system is used. Consequently, it is necessary to have the ability to accurately locate position on the earth's surface in a simple and effective manner, e.g., from conventional survey, etc. using plane co-ordinates.

Each position on the earth's surface has a unique set of co-ordinates associated with it and the ability to reference any point with respect to its true co-ordinates provides us with a notion of absolute accuracy. The actual deviation of the recorded position from its true position is a measure of the accuracy of the point.

Since positional accuracy is involved with measurements, it is necessary to have some understanding of other notions which complement accuracy. For retracement purposes, it is important to be able to re-establish the location of any defined position. This aspect of repeatability is fundamental to the maintenance of the geometric fabric. The ability of the measuring system to resolve finer graduations of distance (length) constitutes an understanding of the notion of resolution while the recording of position in terms of significant digits reflects the notion of precision.

The notion of "absolute positional accuracy" reflects our ability to determine the co-ordinates of any point on the earth's surface. Since the co-ordinates for a given position are often arrived at by a sequence of measurements, it is important to have an appreciation of the role and relevance of accuracy within the content of a parcel system.

Relative accuracy is a term which has its own connotation within parcel mapping. The description of a parcel may be consistent with respect to its geometry and topology. This is to say that, given one corner of a parcel, the remaining corners can be accurately located with respect to the first corner. In like manner, the neighbouring parcels may also be accurately located with respect to each other (i.e., specification of topology). However, the potential accumulation of small errors over distance can result in a potential loss in absolute accuracy over the total parcel system. This can be alleviated to some extent since the measurements of a closed parcel system constitutes a network in such a way that each

measurement is required for "consistency" agreement between adjacent parcels.

In order to put all of this in perspective, it is informative to consider a simple example. Figure 1 shows representative parcels from within a parcel system. The parcel system is referenced with respect to the horizontal control network with two stations X and Y being shown. Each of the parcels A, B, P, Q, R, etc. has its own legal description which should be consistent with each other. The parcel fabric and the street network taken together should account for the totality of the 2-D space within a larger area such as a district, municipality, township, etc. In order for this to happen, it is essential that each parcel share a common definition of boundary corner points. However, this may be inconsistent with the existing individual descriptions (definitions) of the adjoining parcels. As well, the shared corner co-ordinates (cadastral corners) must also be consistent with the horizontal control co-ordinates (e.g., X, Y in our case).

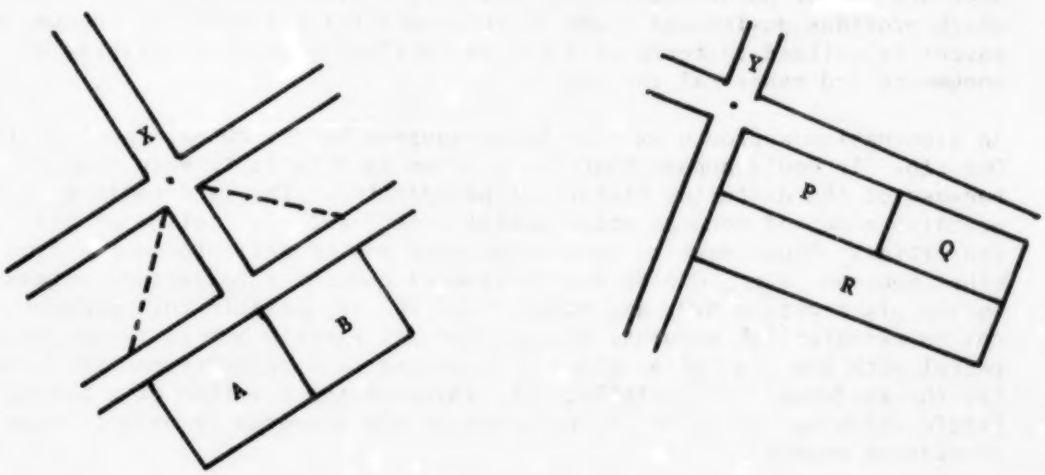

Figure 1

Within a data base perspective, the parcel data base must be seen as providing a consistent image of the ground by following a number of simple concepts:

1) All data elements "register" with respect to each other. This is usually achieved by having a single definition for all data base entities, e.g., cadastral corners, shared boundary segments, etc. Hence, each parcel is defined in terms of "logical" segments which reference unique "physical" segments. Each physical segment is unique while there may be many instances of logical segments pointing to the same physical segment.

2) There must be a single common referencing system so that all points are related through the same positional frame of reference. In our case, the horizontal control network provides the frame of reference.

3) The dependencies of the data entities with respect to each other must be recorded. Hence, should a data item change, all other data entities which depend upon this item for their definition must now of necessity assume a new definition.

It should be noted how these concepts are currently being applied. The City of Calgary system, referenced in a previous paper, is based on the establishment of an accurate positional framework for the parcel base. This was achieved by extending the horizontal control network by placing monuments at each intersection of an essentially rectangular street network. From this horizontal control network the positions of cadastral corners was readily determined by accurate survey methods. These points too can be seen as extensions fo the horizontal control network to provide a single comprehensive positional reference network. The points are the basis for describing all spatial entities (parcels, streets, zones, etc.) within the City of Calgary. The essence of this system is to have an accurate set of points consistent with the horizontal control network, which provides positional frame of reference for all parcels. Hence, each parcel is defined in terms of a set of "defined" points consisting of monuments and cadastral corners.

An alternative approach is that being adopted by the POLARIS project in Ontario. It would appear that the problem in Ontario is more complex because of the differing historical perspective. The land registry system contains a set of records which contain the legal description of all properties. These must be reconciled with positional information from other sources, e.g., COSINE for horizontal control information, extensive survey plans within MTC, and MCCR, etc. The emphasis in this project is not to re-establish accurate surveys for all parcels but to reconcile each parcel with the available evidence according to a priority ranking scheme for the evidence. Essentially, this involves the creation of a parcel fabric which accounts for the contents of the property records in some consistent manner.

Whereas in Calgary the emphasis is on establishing an accurate parcel base in terms of position, POLARIS is establishing an accurate inventory of ownership and reconciling position from the best available evidence, from which a set of parcel maps can be produced. This approach may not necessarily establish an accurate positional parcel base consistent with the survey records since compromises may well have to be made.

The second type of accuracy associated with parcel systems is descriptive accuracy. In this case, an attempt is made to provide a faithful recording for the correctness of all details associated with the land maps, e.g., land ownership. In this case, the information that is maintained is attribute-value information in which the characteristics of the associated parcel fabric are maintained. The various details that are recorded include: metes and bounds descriptions, ownership data, etc.

Approaches to Building a Parcel Data Base

There are a number of ways in which a parcel data base can be created. Each approach has its own means of exploiting specific technology for the creation and maintenance of the parcel fabric. These approaches can be summarized as follows:

1) Establish a positional base in terms of horizontal control network. The approach relies on the exploitation of a geodetic control network. The control network is extended by field surveys to integrate all cadastral corners. Co-ordinate geometry is used to establish a consistent geometric framework between all known points within the network.

   This approach has been used in a variety of municipalities in Canada, including Calgary, Alberta and Burnaby, British Columbia. Obviously, this approach produces a highly accurate and consistent parcel fabric, however, the associated cost is very high. It is difficult to establish exact costing figures since intially some of this work was done under other development projects. However, prices in the range of $20 to $100 per parcel have been quoted. It is reasonable to expect that the costs in the order of $20 to $40 per parcel can be expected in establishing this type of geometrical consistency.

2) Photogrammetric means. It is possible to use the photogrammetric technology to extend the horizontal control network. The individual parcels and lot fabric are identified through best available evidence and digitized and recorded by use of photogrammetric techniques. Aerial triangulation can be used for bridging within a comprehensive control network to establish a photo control and extend ground control.

   The limitation of this approach is the ability to accurately resolve and locate boundaries on the photography. The technique has been used in an experimental capacity using ortho photographs to establish cadastral systems. Experimentally, accuracies in the order of one metre can be established with supporting ground truthing techniques.

3) Digitize Existing Graphics. Perhaps the least expensive method of creating a digital parcel data base is to digitize existing graphics to create a digital mosaic of a parcel structure. In this technique, all existing graphics, such as registered plans of subdivisions, index maps, as well as any other planimetric depictions are used to create a parcel fabric map, which is then digitized. It may be necessary to do some limited manipulation in order to create a "best fit" spatial structure.

   This approach provides means of creating a parcel fabric in the least period of time and with minimal cost. It is clear that the actual source graphics will limit the degree of accuracy of these final parcel fabrics. However, it is possible to improve the accuracy of the parcel fabric with time as better information becomes available. At this time, it appears that the digitization of parcels based on the evidence

available from a variety of municipalities, ranges from $1 to $2 per parcel. The emphasis of this approach is to create a parcel fabric to which a variety of information may be associated by maintaining the spatial structures, i.e., the relationship of the parcels to each other or the topology of the parcel fabric. It is possible to provide a topological structure for realizing various analyses such as network flow structures, utility reliability, etc.

In each of the above aproaches, a number of techniques have been implied in creating a parcel fabric. These include the direct measurement of distance along the ground, the use of photogrammetric methods specifically stereo compilation, as well as a variety of analysis techniques including co-ordinate geometry and least squares adjustment. In the creation of a digital parcel data base, it is also necessary to be able to provide direct digitization for the encoding of spatial structures.

SUMMARY

A parcel data base provides a number of basic functions including:

1) A co-ordinate representation of a legal survey network. This is used for the description of spatial structures including sub-divisions, road layouts, etc.

2) Co-ordinate definition of parcel for mensuration, for example, the computation of area perimeter, etc.

3) Providing a geometric framework for analysis of spatial relations between parcels, e.g. for legal notification of zoning changes.

4) An enhanced information base such as the storage and maintenance of ownership boundaries, the creation and management of thematics, etc.

5) The structured information environment for spatial analysis including point and polygon computations, polygon overlay, as well as buffering to ascertain the limits of corridors around point and line features.

The essence of a parcel data base is to provide a comprehensive information system for use within a municipality to maintain in an orderly manner all of the information associated with parcels. This information is required within the context of a municipal information system for the day-to-day business of a municipality as well as for long range planning and analysis purposes.

The emphasis and the creation of a parcel data base system is in the creation of the parcel fabric and the maintenance of the associated information. Whereas accuracy is an important consideration, the absolute accuracy of the individual parcel does not seem to play the perceived role that is envisioned by many of the users of this information. In this sense, relative accuracy has greater meaning than absolute accuracy.

CHAIRMAN SCOTT: Thank you very much, Jim. I think that, again, from some of the information that Jim gave you at the beginning, you can see, if you put that together with what you heard yesterday that although the people who were involved in the User Needs Study may look back and think of things that they might have done differently, you can see that they have not undertaken the task lightly, that a great deal of effort went into determining what they have found out today. And also, of course, Jim has gone on and talked about accuracy and precision a little further, perhaps it has expanded your thoughts about those things a little bit more and that might be helpful, I would hope, in our group discussions that we want to take place.

Before I bring Jack Dangermond back to give you some further thoughts on some other aspects of what we are dealing with today, one of the things that falls out of or lies within the area of accuracy, is connected with the co-ordinates that would be developed, and I think that, Wayne, you expressed to me some concerns that you had in terms of the co-ordinates that may be developed by whatever means. Would you like to talk about that for a moment before we move on?

Q: Wayne Brubacher (Regional Municipality of Waterloo): Thanks, Ray. As a member of the Assocation of Ontario Land Surveyors, I think we surveyors as guardians of the public interest relating to the establishment and re-establishment of boundaries between interests in land, we as a group are going to ask this seminar if we can be assured that the co-ordinates that are produced either through digitizing or through a co-ordinate geometry process such as the POLARIS Program uses, if we can be assured that those co-ordinates will be forever invisible to the user. That may seem like a strange thing to ask, but we perhaps more than the others, have an insight into the dangers that these co-ordinates may cause. They may fall into hands of people that do not have an appreciation for how they were created. People that have not been at this seminar and others who have not continued under continuing education and kept abreast of the developments in the industry in the field at large. People who are on the fringe of either surveying or engineering but who know how to run transit, they know how to work with co-ordinates, who may in fact say, "Here is a control monument, I know the co-ordinates of that, I know that it is positionally correct, the absolute position of it, and here I have a property corner. I know that if I turn a certain angle and go a certain distance I will be able to set that property corner." Of course, that is wrong, and not only that, it is illegal. I would like some comment on what is going to be done about those co-ordinates in keeping them invisible to the user.

CHAIRMAN SCOTT: Do I have a rush of volunteers up here to give some comments on that? Would you like to comment on that, Jim?

A: Dr. J. Linders: Sure, why not. I believe that there is a variety of reasons for keeping those co-ordinates, one of which is for display purposes. I think the parcel maps that are used in the municipalities are really for display purposes only. I do not think they have any legal basis. And I think that the aspect which relates to the legal survey

fabric is not the business of the specialists in information systems. The systems that we are talking about putting up are systems which are spatial information systems and which have co-ordinates which may be visible to people, but for display purposes. I believe the mandate for landownership rests with somebody else, and this is an issue that should be addressed by others. I would like you to recognize that what would be in these systems would be co-ordinates which have already been used for display purposes and perhaps planning functions, but do not have legal basis. This is the biased perspective of an information scientist.

CHAIRMAN SCOTT: Thank you, Jim. I will also respond to your request. I do not think, certainly, that we have time here today to investigate fully the issue that is implicit in your remarks, because certainly it is an issue. I think that all that I will probably say is that as far as the POLARIS Project goes, it was certainly not intended that the co-ordinates which we developed will be a legal definition of properties. I realize that as long as we are simply handing out hard copy property maps, the problem really does not surface. If we began to hand people a tape with our data on it, then it can begin to surface and I think it is something that has to be explored and looked at very carefully before we ever get to the point where we are doing an exchange of electronic data between people. And I think if we can sort of leave it at that for now, but it is not an issue that is going to go away, that is for sure.

Alright, before we get into our discussion groups, I am going to ask Jack Dangermond to come and talk to us for a moment again, and Jack again will touch on accuracy a bit, on the pilot projects that are proposed and also on the specific actions that you might take in your own municipality. Jack. (Applause).

JACK DANGERMOND: Good, thank you. So what we talked about last night was a strategy for how we might conduct the workshops and discussion groups that are going to happen next. And it occurred to me that in your minds we called all of the answers for how this is going to work out. Notice I used "minds", because we have all sorts of points of view, sort of like I want more accuracy or I do not want more accuracy, or I think this ought to be the pilot project or that ought to be the pilot project or we should not do the pilot project, or this is what we ought to do next year or it is not. All of those are in your minds here and they are held in different minds. So what we want to try to do is get some sense of consensus so we can move forward. And that is what the real function of the little discussion groups is going to be.

So how do we begin to elevate that set of priorities in our minds so that we are open enough to talk about it and get some consensus? That is the purpose of the next hour. I want you to be with me on that as we go through these discussion groups, elevate your mind to the sense that everybody else has ideas in her that you may learn about and through this discussion-interaction you are going to get some consensus and clarity so we can operate in the next year. Are you with me on that?

As an exercise, what I would like to do is take two minutes for each of three subjects and let you just think quietly with yourselves about what your opinions are, what your points of views are about particular notions,

and I am going to go through these three ideas and you might want to jot some notions down for the purpose of discussion in the discussion groups.

So, are you ready? The first one would be accuracy. What I want you to think about is the notion of accuracy and what it means to you. What is the thing that comes to mind in your mind, when we talk about accuracy, not Webster's or Oxford's or whatever, some notions about what you think about when you consider accuracy. And what you think about in terms of mapping with respect to accuracy. What your opinion is about what ought to be accurate. What has to be accurate and why. And the notion of accuracy with respect to maps defined with geometry, co-ordinates and topology. I want you to think about some of the cost benefit notions of this term that you hold in your mind called accuracy. What comes to your mind when you think about the costs/benefits of accuracy.

Good, so now I would like you to think about one final question with respect to accuracy and it is a loaded question, but it will stimulate your mind. You can either react against the loadedness of the question or with the loadedness of the question, but I am going to ask the question. And the question is, "should we hold back going digital in mapping, until we can afford to do it precisely in your definition?" Follow what I mean there? That is considering costs and benefits of accuracy should we hold back in going digital until we can do it more precisely. That is truly the question. Okay, let us tear off that sheet of paper and move on to another one. So you have some thoughts about that now to talk about, to think about and express opinion about.

The second general topic that we want to talk about is pilot projects and again begin to elevate your mind about your involvement in the pilot projects. Now there are lots of ways to be involved in the pilot projects. There will be like direct involvement, you are actually participating with the pilot projects, I mean it is your city, or your agency that is affected. And there is the involvement of kind of being tangent, chilly involved or related to it or participating and contributing with it, but not with your data, and then there will be kind of like observing the process and giving comment type of participation, and then there will be sort of like actively reading it and following it and talking with the people who are directly involved, and then there will be a little bit less participation where you kind of like occasionally read about it, and then there will be the participation where you are just, maybe next year, coming at the seminar and hearing about what happened. And then there will be the level of participation where you are not even interested, and then there is the level of participation where you are absolutely against the pilot projects. It goes like that. So you have a kind of a scale of participation.

So what I want you to think about is the level of participation that you want to participate in in the pilot projects. For you to be clear about that, I want you to think about the type of projects that are important to you, in other words, if the projects are going to go on, why not play, it is more fun to play than not to play. So what types of projects do you see that are important and critical right now to being able to make this thing move forward. What is it that you are interested in, not sort of like what they are interested in, but I mean YOU. What is it that is really

fundamentally important to you that you need to have ferreted out in a pilot type of project. What are the answers that you want to have show up in a year or two about this technology or that stuff. You know, how expensive it is, or does it work or is it going to work out, you know, that stuff. So make a note of the types of pilot projects, generically if you like, that you would like to have worked out. In that, figure out what you want from the pilot projects, make it real selfish, you know, what you want, not what philosophically ought to be done. What would really help here.

Okay, good. So, tear off another piece of paper. We will deal with Subject #3. Subject #2 suggested that pilot projects were the way to do it, that may not be so. That is pilot projects as you have seen in the methodology, kind of like the next step to begin the prototype, the results that we got out of the study, so that we can see if they really work, validate these notions that we have. So that might not be it for you. So in case that is not it, what do you think we ought to do in the next year, or next three years or next five years? It is not being done now, nor being talked about, or being done now. What do you think about that? In other words, the actions specifically, let me read it to you. What actions would you like to see done in the next year about this general subject of land-related information systems. What would really help you beyond just pilots. What do you need and want, that somebody can do something in the next year about with respect to this subject. Do not block yourselves into, what can the Province do for you. What needs to be done next year. Make this move forward.

Why don't we begin to wind it down. Okay, what we are now going to do is this exercise where, in a moment, we are going to have some of you turn around and face your neighbours right behind you. We have a system for that. But, no way to maintain the data. What we would like you to do is, turn around in a moment and face the people behind you so that we make like little round tables, and then we would like to have some kind of a data handling system, namely, in a spokesman. So what I would like you to think about is, within a table group nominate a spokesman who is going to record, take the notes that you have written down and record the key points of your little discussion that will go on for about an half hour. Then we are going to have some sharing, right after coffee, about that. So label each of your tables. Take just a moment, look at the centre of your table, there is a dot there, a coloured dot. You see it? The system is not working. Notice that they are either yellow or orange? Yellow stays, orange turns around. Do that quickly.

Appoint a spokesman quickly and then get on with the discussions about your notes. Do not forget to appoint a spokesman!

CHAIRMAN SCOTT: You are going great. And we are going to give you an additional five minutes and then we are going to ask you to cut it off, so keep it up.

It is 3:05, when you come back we will get your reports and even if you have to bring back your coffee, could you please try to be back by 3:20 because we do have to vacate this room by 5 o'clock. Thank you very much.

- TO DISCUSSION GROUPS -

CHAIRMAN SCOTT: Everybody can take their places, we shall have to try to get under way. Richard Groot is going to do the summation for us later on and he has a plane to catch, so we are going to try to stick to our schedule if we can. Right now it is "show-and-tell" time. You have all appointed a spokesman and that individual is going to tell us the results of your deliberations and we have got about 20 or 21 groups to go through. We have not got a lot of time, so I am going to ask you to try and limit your presentation to about a minute if you possibly can. If you can get to one of the microphones and identify yourself, then we will start off overhere.

DISCUSSION GROUPS

Report #1: Charlie Tatham (County of Oxford):

1. With respect to the question of accuracy, our group wants to know, is it reliable? Can I have confidence? With respect to relative accuracy, the group feels it should be whatever will get the job done. Relative accuracy satisfies most clients in the city. Some have said, go right ahead there. Some have said invisible co-ordinates are required.

   Should we hold back until we have accuracy or wait until the majority of clients are ready? If you can update co-ordinates, go ahead when the majority is ready to go digital.

2. Regarding the question of pilot projects, the group is in favour of going ahead with the pilots. Demonstrated results from different types of applications would be the goals of these projects. Our group felt that they would all like to be involved in some active way with the pilot projects. Pilot projects have a high profile and will demonstrate information exchanges, what is happening, and what initiatives are taking place in these pilot projects. The pilot projects should ensure that more thoughts and ideas regarding G.I.S.'s are formed and new and better models can be developed. We should study cities that are now commencing, and see how they are doing, how they are progressing. Some in the group have said, no comment.

3. The pilot projects should strive to get more people involved, generate an awareness program with the Provincial Government giving leadership and basic standards.

CHAIRMAN SCOTT: Thank you very much. Okay, group number 2, you are on.

Report #2: Ralph Smith (Metropolitan Toronto):

1. The group generally concurs with everybody else, in that there are various levels of data required. You can get started with a G.I.S. Remember when we were talking about G.I.S., Geographical Information Systems, and finally figured out what that meant. Namely, geoprocessing using maps as a display tool for communicating ideas. That is not engineering, it is not design and it is not construction, which are also a lot of the things that municipalities do.

   Back to the question of accuracy for G.I.S.; the feeling was that generally you could take a combination of the existing statistical files at Statistics Canada and come up with co-ordinates for various addresses and houses and commence with geoprocessing. If you wanted to display that data, you probably should better match it to the 1:10 000 scale maps, otherwise the streets are going to be one street away from

where they actually are and it might be a good idea to reconcile those two. Higher accuracies came down the same. Looking at what is the next major application the municipalities have been planning in the administration, namely engineering and that requires a different setup which is a long-term gradual updating of certain features and supplementing with other features.

The group talked about legal surveys and said that legal survey data is not really part of the map display data, it is attribute data. That is information you store; for example, if Joe Blow claimed on a certain date that he knew the property corner co-ordinates, he could store that information as attribute data.

2. With respect to pilot projects, the group said something about, "There is a lot of parallel research and development going on. Could we not get some of this together?". The type of things that they should get at, initially, is that again, you cannot use Statistics Canada data because you have not cleaned up your own act with regard to data. You probably have 16 files with addresses in them and none of them agree with each other. One for water services, one for taxing, one for hydro, one for whatever. So some work needs to be done in cleaning up your street name file to start with, then cleaning up your address file, and then figuring out if the Province could do what they did in the U.S. Federal Government, namely, taking a DIME file, which is like our Statistics Canada file, and writing some programs that could translate DIME file information down to the local level where it could be used. The U.S. Federal Government has done some work in address matching, so it is possible to start to reconcile types of these things. So there is a lot of work to be done before you really plug into any type of the information systems. And possibly some of that homework could get started now.

3. There is one area that I raised, but nobody was listening. (Laughter) We talked a lot about technical stuff, and I would hope in the next stage of this, they start looking at the legislative side of this issue. We (the municipalities) should not be doing any of this. Probably, the Province should do it all and give it to us because we have no mandate whatsoever for this in the municipalities other than to keep street addresses and keep original planning files. We have no requirement to keep co-ordinates, we have no requirement to keep maps, we have no requirement to keep utility information. Nothing in the Municipal Act mandate has to do with that type of thing. Everything we do so far is done as an administrative support service to some operating department. If engineering is popular today, we try to hook ourselves on to the Engineering Department, if it is transit tomorrow, we try to hook ourselves on to the Transit Department, and we keep moving the responsibility for this data base around. So maybe take into consideration that the Municipal Act says, you can appoint a municipal surveyor, but it does not say what his job is. It does say for the engineer what his job is, but not the surveyor's. The new Surveyors Act spells out a bit about what the surveyor's job is with regard to information systems, but maybe your Committee should start looking at who should be doing some of the stuff, because we sure do not have the money, and we were not mandated to do it and you are

trying to slop it all off by setting up files and saying that we put data in. (Applause)

CHAIRMAN SCOTT: Thanks very much, Ralph. I think he let us off easy. Group number 3.

Report #3: Michael F. Smith (Regional Municipality of Ottawa- Carleton):

1. I would like to echo Ralph Smith's comment. The table that I was at is composed largely of municipal people and therefore the comments are somewhat slanted.

   In terms of accuracy, people are generally looking at something in the range of one metre in the municipal system and something in the range of 5 - 10 metres in the rural system. It appears that the use of the Ontario Basic Maps is certainly limited for municipalities. I think the survey brought that out quite clearly.

   The next issue the group dealt with was information systems. The people at our table at least perceived that what the Province is doing here is fine for a provincial information system, a provincial map, but the use is very limited in, certainly, larger municipalities.

   The question of vertical scale was not addressed, although we did discover the Conservation Authorities are doing their own maps at a scale of 1:2 000, which I think is all part of the same problem, namely, the mapping scales.

2. The opinion at the table was that we should not hold back in terms of waiting for accuracy but simply to plunge into things like pilot projects, which is number 2 on the list. Everyone is interested in pilot projects, in keeping abreast of the new technology and there is an overwhelming view at the table that POLARIS, especially, should be pressed forward and perhaps more communication kept with municipalities across the Province. Everyone seemed quite interested in that.

3. As for the next three to five years, I think people are looking to the Province for better liaison, more technical liaison, perhaps for the Province to play a leading role in setting standards for the users and industry in this field of digital mapping as opposed to perhaps taking a back seat. Maybe Ralph was getting at this point.

   There is a need for more pilot projects and funding. Send more money, I guess, is the way Ralph put it. The bottom line is that people are here to keep abreast of the technology and the municipalities are interested in keeping abreast themselves and getting some funding, perhaps to do their own work or take the lead. Thank you. (Applause)

CHAIRMAN SCOTT: Group number 4.

Report #4: Peter Chisholm (University of Guelph): I am here by default. I was issued a fiat to be the spokesman. So here I am.

1. First of all, on the question of accuracy we set out some criteria. The first one was, we do not think that we need accuracy consistent with legal evidence, but rather something less than that. We wanted relational accuracy that would avoid overlaps and we want locational accuracy that is consistent with the reference grid that the geocoding system is being referenced to. In engineering terms we thought in terms of accuracy consistent with predesign and feasibility, but not for final design, it is not good enough for final design. And the fifth criterium was accuracy consistent with land value, in other words we do not think that we could justify a uniform limit on accuracy for the entire Province.

2. About pilot projects, everybody in the group felt the Province should go ahead with pilot projects. We have a mixture in our group from the private, municipal and the educational sector, and all felt that the technology is important and that there is no point in trying to avoid it. However, we have a couple of suggestions. We heard this morning that some municipalities are more interested than others, and we would encourage a steering committee within each of those interested municipalities to liaise regularly, as invited this morning, with the Management Committee for the Pilot Projects, improve liaison and improve information flow. We are concerned about the personal development training content. Most of us are fair, fat and forty at least; we are new to much of the technology and we want to see that kind of content present in the future.

3. The third real difficulty was the question of professional integrity and we said that it is all too easy to hold the words of a data base, but you do not necessarily hold the concepts. So, if we are going to use this technology, there is a lot of educational content in it. We see a big interface problem. The planners and designers are speaking one language, the computer people are speaking another in terms of electronic data processing, and we did not hear very much today or yesterday about the interface between these two disciplines. We have an analogy and that is that there is a recent initiative in the legal profession to take the legalese out of the contractual arrangements so that lay-persons could understand the concepts.

   Now with regard to the last point, perhaps in the form of an exaggeration, most of us thought that we are less interested in the data bases themselves than we are interested in the data base management systems. What can we do with these data bases, what kind of problems can we solve with them. There should perhaps be a little clearer development of the relationship between the data base and the data base management system itself. This might be helpful to all of us. Thank you very much. (Applause)

CHAIRMAN SCOTT: Thank you. Next group.

Report #5: Jerry Nuttall (Metropolitan Toronto Planning Department):

I think the previous speaker put a burden on me because he was very effective. Our group contained four surveyors, an engineering planning consultant and two planners, and I guess I have to say that our group was very tolerant because we introduced irrelevancies and we did not really focus in on the three major issues as they were drawn to our attention.

1. On accuracy, the general feeling was that for engineering purposes, route location can be adequately handled. If you have OBM maps you need the accuracy and you can do your preliminary design on the basis of that information and you only have to depart from that when you are in the final design of a project. Therefore, the group thought that accuracy was not really the issue. I think also there was agreement that you could always continue to build on whatever accuracy you established in your original types of definition.

2. When we came to the second point regarding pilot projects, the group felt that their involvement on pilot projects would be in the form of a second team approach and that we would be interested in being kept abreast of what was going on and being able to interact with the groups that are doing the work so that we are fully conversant with the details.

3. On the third point, this is where the planners ran wild with respect to the terms needed to approach the pilot projects. What was not said in all the discussions that we have heard throughout the two-day sessions so far, is regarding the accuracy of data other than positional data. I think this is a big area of concern. Recently in the Province of Ontario we suffered a severe degradation of our population data as a result of unilateral actions by the Ministry of Revenue and for those who are not familiar with the extent of the degradation, I would like to suggest some numbers. The Statistics Canada enumeration undercount talks about a 2.4% undercount or something like that. I think in all fairness to Ministry of Revenue, for several years their undercount may have been 3 or 4%. However, the position that was taken by the Ministry as a result of the cut-back in funding that they have experienced, was to decide to do a comprehensive enumeration every three years. Now in the intervening years, one could estimate any sort of degradation, maybe 15% degradation of the data, but in terms of particular data elements such as the children who were born into the community in that period, you could have a 50% degradation. So, I think one of the things we would like to see go on along in parallel with the development of this excellent system, would be a look at the type of data that is going to be added to the system that is oriented to the parcel, but is not geographical data per se. I think that should be looked at and it should be a determination on how to improve the quality of that data.

   The other elements that need to be addressed would come from the very helpful source of the Systems Departments. I understand there is a Systems File that has very poor definition, and we would like to think that one of the pilot projects should be looking at the type of data

that would be merged into the system, that would be used with the system, so that it would be more effective. We cannot work by thinking "garbage in, gospel out", because what we are going to get is garbage. Thank you. (Applause)

CHAIRMAN SCOTT: Thank you very much, Jerry. Next group.

Report #6: Jim Purcell (Ontario Land Surveyor):

1. At our table we have four Bell Canada people and three land surveyors, and two of the land surveyors stressed absolute accuracy all the way. Until last night at the workshop I would have done the same. The Bell Canada people feel that relative accuracy is good enough for what they are interested in, and at this point I am sitting on the fence. But I say relative accuracy is currently economically feasible and absolute accuracy should be the goal in the end. Aleks is going to answer the second question.

Aleks Kleniewski (Bell Canada):

2. As Jim said, our group is split between Bell and surveyors so we have a few different viewpoints on the pilot projects. Both groups feel that the pilot projects should go ahead, but one of the groups is really attempting to act as an agent for the municipality, that is their whole idea of why they want the pilot projects. The other group is interested in refining the contract costs in the context of a project that they are considering.

   Over and beyond that, through the pilot projects, we would like to assess the viability of digitized mapping which would provide a foundation for better management of our network facilities. We are looking at the pilot projects now, so we say yes to that, and we really did not address the third question.

CHAIRMAN SCOTT: Thank you very much, Aleks. (Applause). Next group.

Report #7: Rick Weatherbe (Marshall Macklin Monaghan Ltd.):

1. On the question of accuracy we felt that the framework for the municipality itself should have a high relative accuracy, otherwise things would not fit together. It does not have to be absolute, except in connection with exterior data bases, such as other municipalities in the Province. On the interior you are going to be fudging everytime anyway, so a couple of metres accuracy is going to be fine. Everybody is eventually going to have a very high precision data base, thirty years from now or sometime in the future, but not right away. There were some doubts expressed about retroactive accuracies, in other words, being able to fix something now and have it fix all the mistakes of 20 years ago. There are some doubts whether we can do this.

2. On the question of pilot projects, it was a definite yes to go ahead. You have got to come up with a preliminary system at least. The pilot projects are going to come up with two kinds of answers. The first one is implementation, for example, how to implement these things. There are going to be generic problems that you are going to run into because everybody has got a different situation, every municipality has got different types of data bases. Secondly, the important thing we thought the pilot projects are going to give, is what are we really going to do with these things, what are the end users going to do with them, what kind of uses are going to come out once you have got the thing in place. That is not really a question we can answer now, and I do not think anybody has really been talking about it, but that is going to be the big plus that is going to come out at the end of this.

   The other point they made was, that we have got to look at the systems, not the technology. The system being the people and the data. The hardware is a black box and it is going to be different five years from now and it is going to cost a tenth of what it costs today anyway.

3. What do we do next? Basically, watch the pilot projects and do not do it unless you need it. Let somebody else pay for the mistakes and learn from them.

CHAIRMAN SCOTT: Thank you, Rick. (Applause). Next group.

Report #8: Denis DeJong (Genitan Electronics):

We had six people in our group, three from the municipalities, two from the Provincial Government and myself the lone private industry.

1. Accuracy we decided meant different things to different people and that it is really related to use and purpose. To pin it down for parcel mapping and planning 5 to 10 metres relative accuracy would be quite sufficient. However, for engineering street layout, both relative and absolute accuracy are defined as being one foot. The other view on this issue, for streetname accuracy it is really more positional or correctness rather than accuracy. Accuracy has to reflect what actually is on a map or whatever. Really, what is it going to be used for and the cost/benefit trade off is really defined by the use as well.

   Should we hold back or delay? No, but do not go ahead with something that cannot be used, something that is minimal accuracy that will require a lot of changing in the future and in the interim will create more headaches than value. But there should be a gradual change-over. We cannot get rid of all our present way of doing things on paper maps and go entirely digital starting day one.

2. With respect to pilot projects and what is my involvement? Well, I know what my involvement is going to be, sell more digitizers. We had people from Sudbury who want the pilot projects. They want to be in on

it, so there is the plug for Sudbury. The other things to consider in the pilot projects are to build the OBM data base and also take great care in the selection of a universally usable DBMS that can be used by the municipalities both in the pilot projects and later when there is full implementation.

3. Third item, if there is no pilot project, what would we like to see done? I think this was the loaded question. Alternatives? Complete OBM digitally and/or put in more dollars (and this is aimed at the Province) for control surveys. Thank you. (Applause)

CHAIRMAN SCOTT: Thank you, Denis. The front group here.

Report #9: Brock Stanley (City of Kitchener):

Our particular group had a mixture of land surveyors, engineering, data processing, computer scientists, planners and provincial people. We also ran the gamut between representatives from local municipalities, regional and provincial governments.

1. In terms of accuracy, after some considerable discussion, we felt that perhaps this question can be best answered after the pilot projects stage and there should, in fact, be two levels of accuracy based on the staging of implementation. One should have a level of accuracy for the entry of your system and then an ultimate level of accuracy to work towards. Perhaps the best thing that this pilot project can do is to define the costs and benefits of moving from the entry level of accuracy up to the ultimate level of accuracy necessary for engineering.

   The group felt that we should move into digital mapping fairly quickly and that the question of accurate digital mapping should not hold up digital mapping altogether.

2. In terms of pilot projects, particularly the question of the level of participation, in our particular group Cambridge was one of the members, so they are directly involved. The other members in our group felt that there should be more provision made for a closer observation by other municipalities as to what is taking place. Some individuals, in fact, wanted to sit on an observer group and it is our concern that the Province should perhaps set up a mechanism so that people are not kept in the dark for one year and then we get the results. There should be some ongoing basis of observation permitted by various municipalities not directly involved in the study, particularly if those municipalities are looking at those whole areas very seriously.

   We also felt in terms of the pilot projects, that there should be a great deal of attention given to the form of the end product from the pilot studies. I do not think that there has been any questions addressed or any suggestions made as to exactly what the form of the final product is going to be. Is it going to be a big series of reports, is it going to be actual software that can be transported to

area municipalities and we are really asking the provincial people to perhaps give a lot better definition to what is the end form of this product going to be and how is it going to be disseminated out to area municipalities and other people interested in the results from these projects.

3. Finally digging into the question of the pilot project itself, and this follows through to my last comment, can the Ministry make available experts dealing in this whole area to municipalities who are faced with having to make interim decisions, say within the next six months? We tend to feel that again we do not want to wait for a whole year and then find out all of the results. It is clear to us that there are municipalities that are having to make decisions regarding the structuring of their existing data, regarding hardware and software changes within their municipalities, and we feel that it is important that the Ministry people and people involved in the pilot projects should make available expertise on an ongoing basis through this year, so that if a municipality is contemplating some major changes they can approach the Ministry and get an up-to-date picture of what the results are that could affect any decisions the municipalities are making at this point in time. (Applause)

CHAIRMAN SCOTT: Thank you, Brock. John, do you want these notes that people have made handed in to you? Okay, we will start here at the front then. First representative here.

Report #10: George McFarlane (Ontario Land Surveyor):

1. Our table had Ontario land surveyors and some visitors from Alberta. We benefited from the Alberta experience as they have gone through this exercise previously. They felt that they could not have proceeded without establishing a level of accuracy. Alberta had the benefit of integrated surveys when they started in 1968.

   What was agreed upon was that, you should go ahead right now, and establish a desirable level of accuracy when you are designing your system, but start with what is available so you can obtain the benefit, for example, that 95% benefit that we were talking about, without engineering applications. You could obtain that right away and then have an established desirable level of accuracy. You would build up your system towards high accuracy as you went along. Alberta's idea of accuracy was $\pm$ 3 metres in the rural areas and $\pm$ 20 metres in the urban areas. Whereas the group was not suggesting that we do the same in Ontario, I thought I would throw that in so you could see what somebody else's idea of accuracy was in terms of numbers.

   The representatives from Alberta also pointed out that once co-ordinates were in place, the public would want them and it would be almost impossible to keep them hidden.

2. On the question of the pilot projects, we advocate direct involvement particularly of the surveyors and we feel that the Association should

go ahead and get involved and ensure that the co-ordinates that are in place in the system are done correctly and utilized properly, because they are going to be utilized whether we like it or not. We also felt that these pilot projects should develop some sort of administrative system, and thirdly, that they should give some consideration to using the OBM Base Maps for subsequent scanning using the laser technology. Perhaps for conversion of the manual product to digital.

The fourth point that we agreed on is that we do want a pilot project, and we want from it a workable model that could be modified to workable situations to meet the current demands of the municipalities. I think that is what the previous speaker was saying. We want something right now for the people who have immediate needs. We want an idea of what systems, hardware and software combinations, are workable so that we have a choice. And we want some idea of the time and cost factors of implementation at this time.

3. If you were not going to have a pilot project, we found that in areas that would not benefit from a pilot project right now, we should immediately begin to densify the control, and to put legislation in place for integrated surveys. Now the group felt that this had to be mandatory. It was a minority opinion and we felt that maybe the surveyors could be asked to do this voluntarily, but the group as a whole felt that that would not work and we had to get legislation in place to get that done. This would be building up towards the establishment of a system.

   And finally, we felt it was very important that the task force do some promotion amongst the potential users and some education and disseminate information during the period between now and the next seminar. Thank you. (Applause)

CHAIRMAN SCOTT: Thank you very much, George. Next group.

Report #11: Ian Isaacs (EMR):

I represent the group from Legal Surveys Division (EMR). We had somebody from Surveys and Mapping in Manitoba, and somebody from the Municipality of Sudbury and one private surveyor from the City of Lindsay.

1. On the statement of accuracy, we attempted to sidestep the issue completely by stating that maps have a purpose and their purpose should be reflected in a functional statement on that map and the functional statement should be reflected by the accuracy to prepare that map. The initial surveys, we realized, had to be done to the highest positional accuracy, but base maps only require high relational accuracy. The accuracy should not impede the growth of the data base, however, the data base should be labelled in some form that the users of that base be allowed to make a judgment as to whether that data can meet their own criteria.

   Digital representation will lead to some problems, we felt. Numbers

tend to be misleading to some people. However, graphical maps imply relational positions and will not lead to the problems that the co-ordinates lead to. The numbers are simply tools for the preparation of maps rather than implying any legal validity and should not be confused as legal definition.

2. On the pilot projects, we have led off with two questions that the group was not sure of.

   1. What accuracies are the pilot projects trying to achieve?
   2. Why does a pilot project take three years? Are they incremental pilot projects or are they concurrent?

   There was obviously some lack of understanding in the group as a whole there.

   The things we want out of the pilot projects include: dollar per parcel costs, hardware specifications, software specifications, and information packages to other municipalities who are not involved. We want to be able to go to councils immediately and keep them informed while the pilot projects are taking place. We want some guidelines on how to implement the system, not theoretical models but, if possible, some actual concrete steps as to how a municipality can lead off.

   What about the remaining municipalities? What are they supposed to do in the meantime? Are they supposed to sit by placidly and pray and wait for God to come down and tell them what to do? We feel that it is important that co-ordinated groups be established immediately:

   a. to hold their hand and ask them to be patient, or

   b. to lead them in the right direction so they do not go off by themselves and create independent data bases.

3. In the future we felt that the most important thing was that user needs studies could be carried out by other municipalities that have the resources and the desire to do this.

   And most importantly, this group or this seminar should lead to educational seminars for the rest of Ontario who are basically left out of the pilot projects at the moment. We felt that where user needs studies have been done by municipalities at the moment, these models could be implemented with some guidelines immediately, not after three years.

   And lastly, there was a concern expressed that we should continue with the development of a standard interchange format, not only for the large system vendors, but for the small ones as well because a lot of private industries are going to be able to purchase these small systems. You want to ensure that the work that they do for the municipalities is integratable. (Applause)

CHAIRMAN SCOTT: Thank you. Next group.

Report #12: J. Stanley Cotterill (Regional Municipality of Niagara):

1. Being four surveyors and one engineer on the question of accuracy, all felt that we would like to have the Utopia of absolute accuracy, but I think that we also all agreed that we would not wish the system to wait until that can be attained, that should go on and that we can live with a lesser degree of accuracy for however long it takes. However, any system that is designed should be upgradable, open-ended, so that it can be upgraded to better accuracy. And we also feel that there should be some way of advising the users as to what degree of accuracy is there now. I think we recognize that in any municipality you are not going to have homogeneous accuracy. In one area you may have integrated surveys in one block, and in the next block you may not. So we would like to see something added so that whoever is using the data can recognize what, in fact, level of accuracy is there.

2. As far as pilot projects are concerned, get on with them and keep us informed. We hope that from the pilot projects you will develop a framework for some useful user input, that out of the whole thing, and maybe this is partly in answer to the third question as well, we would like to see some dictionaries of terms, some guidelines and specifications as to how to set up and code information. Some specifics on geocodes are needed as well as what type of geocodes are going to be the most useful.

3. Basically, this time next year we would like to have some indication of progress so that we can start to organize our data. We may or may not be in a position to buy a system, but we are going to be collecting data and we are going to be filing it somehow. So the sooner you tell us how to file it, the less stuff we are going to have to go over when the time comes to implement the system. I think that it is very important that we get some kind of guidelines as to how to file things. And definitely, expand POLARIS, get on with it. Provide us with those parcel maps and parcel identifiers. We want it all and we want it now and we would like to have it free. (Applause and laughter)

CHAIRMAN SCOTT: Thank you, Stan. Next group. Have we got any more back in this row or does that finish this row? Okay, I am sorry I did not see you.

Report #13: Anne Boud (University of Toronto):

We had a pretty good group, I think. We had three from the municipalities (two engineers and a planner), we had a land surveyor, and me from academia.

1. As other people have concluded, accuracy depends on application, but one thing from a presentation standpoint is that graphically your data must look good or you lose your credibility. So the relative accuracy

must be good. We say accuracy in areas depends on the area itself, so rural accuracy need not to be as great as for urban accuracy. We came to the conclusion that half a metre horizontal accuracy, ten centimetres vertical accuracy is a good enough accuracy for engineering purposes, but the planner said he does not mind and within one block accuracy is good enough.

Another thing to remember is that you cannot put data of different accuracies on one map and expect to have the best accuracy that you are using for that map. The accuracy is your lowest, your worst level of accuracy when you put different data together.

2. For pilot projects every municipality must be kept involved. We want progress of the OBM mapping projects and everything like that, perhaps every six months. As a university researcher I want to know what to do. And also, you need local co-ordination between the assessment data and POLARIS because data is coming down from the province. We want a two-way co-ordination between the province and the municipalities.

3. The third question was with respect to what to do next. We want more detail on survey work and on parcel mapping, not just digitizing existing maps, so get on with the actual real work that has to be done. Speed up the Ontario Basic Mapping Program and hold back on POLARIS. There are even mumblings to kill off POLARIS so that OBM can get finished. OBM should be digital, it should have been digital from the start; why it has not been digital from the start is a credit to pressing efficiency as far as I am concerned. (Applause and laughter)

   The municipalities must be given money to encourage them and also a study to show the cost-effectiveness of why digital mapping. They need some sort of study that actually gets down to figures and proves why we need it.

   We need more seminars and more workshops because we all love chatting to each other. And I would like to point out that you must remember that maps are only one representation of a three-dimensional information base. So there are more things to look at. Thank you. (Applause)

CHAIRMAN SCOTT: Thank you very much, Anne. Does that finish this row? Is there another group left there? Alright, we will be moving across one row and start at the back of the next one.

As these people report, you begin to get the feeling that all is right in the world. There is a surveyor everywhere. (Laughter)

Report #14: Roger Welsmann (Barrie):

1. On accuracy our group was of the opinion that rough accuracy is satisfactory to get the system started, but should be improved as time goes on. To the surveyors in the group the accuracy meant working above the minimum. To the planners accuracy meant depicting what was

there. And somebody mentioned the situation of using an NTS map on a canoe trip and being quite surprised to find that there is a 20 ft waterfall on that corner which did not show on the map that you were following.

What has to be accurate are the fixed visible features. The reason for that is because the planners base their decisions on these fixed visible features.

2. As to the second question about the pilot projects, our group was not sure that pilot projects are the answer. We would like to have an established project to use as our model.

3. The third question, what should be done from now on during the next three years? We feel that there should be a requirement for co-ordinated surveys. And I, personally, should learn more about computers and we should all try to educate councils on the advantages of digital data base systems. We feel that the OBM should be made the basic mapping in Ontario and we understand that it is not. Somebody mentioned that the Ministry of Agriculture and Food has just contracted to have 2,000 maps prepared. I understand that they are not Ontario Basic Maps. The minimum requirements are that all work should be compatible with the OBM. And we also feel that there should be something done to standardize the computer software as we progress with the system. Thank you. (Applause)

CHAIRMAN SCOTT: Thank you, Roger. Next group.

Report #15: M. H. MacLeod (Georgetown):

1. Our group quickly got into a discussion on the idea of accuracy, the relative accuracy and absolute accuracy. We ran into problems immediately because our group has such a wide diversity of application. We had fishery, agriculture and landbank people, planners, engineering and gas utility people in seven people, so that represents a data base range from 1,000,000 to 2,000,000, which satisfies the needs of one end of the spectrum down to 1 to 50,000, 1 to 10,000, 1 to 2,000, 1 to 1,000 and 1 to 500 scale mapping, so obviously this wide diversity of opinions was our problem.

   We feel that a system should be accepted as accurate as possible for that area, in what that area can afford. Obviously, the higher accuracy in the starting base, the greater number of happy customers. Alberta's lead in three metres in the rural areas down to twenty centimetres in the urban areas expresses that nicely. The answer obviously rests somewhere between the highly accurate system and the quick and dirty system which Ray suggested this morning.

   We did emphasize the need for co-ordinates on the ground so that a lot of people can get started on that without having physical points on the ground, the first, second, third and/or fourth order points.

As to the question of pilot projects, yes pilot projects should go ahead. We tried to get some interest indicators, like Jack asked for percentages from 100% down to 0% or ranging down to -20% or something. We tried to get percentages from each group. They were quick to put the percentage numbers on there, until we suggested that in some cases that might mean dollar backup, and so they backed off. That is when we took the percentages off and we ended up with the input would be either hardware, software or humanware and/or dollars. Everyone expressed an interest to go ahead with input immediately, right now. We did like the idea of an education/information centre, which was put forward yesterday.

3. The third question dealt with actions to be taken if there were no pilot projects. Certain actions we suggested would be information dissemination, user needs studies on an individual area basis and political pressures. We should educate the administrative upper level. Administrators' actions should include that everyone should start now. We discussed the computer data bases at large and decided there is a need for definitions and a need for standards. And then we did suggest that a seminar like this be sponsored for the politicians. We are talking to each other and it is great to talk to each other. (Applause)

Report #16: Keith Hall (City of Burlington):

Our group was composed of a municipal user, a municipal systems person, two Ontario land surveyors and a mapper. And really consensus was not forthcoming on too many subjects.

1. On the subject of accuracy, we questioned whether the user really knows what kind of accuracy he needs. We feel we have to distinguish obviously between positional accuracy and tabular accuracy. There are many users of this data base, whose level of accuracy do we adopt? Again, we are forced into a position, we feel, of looking at the cost/benefit of all levels of accuracy.

   Should a municipality digitize using its existing parcel maps? We feel there are a couple of questions that must be asked first before answering this question. Is the data correctable after they have completed digitization, and secondly will it ever get corrected? On the other hand, we are reluctant to postpone and we feel that it may destroy the whole program by insisting on a high level of accuracy.

   As an analyst I see the first requirement as accurate tabular data rather than accurate positional data but recognize the need for very accurate relational data. There is some question about the premise that poor digitized data could ever be updated in the future. There is a general feeling I suppose in our group but definitely not unanimous, that the base should be accurate, very accurate from the start and that this responsibility should not lie with the municipality.

   We all felt that it was very early in the game and we are very excited

about the possibilities of watching the results of the various pilot projects.

2. On the subject of participation in those pilot projects, the land surveyors were in a watch-and-wait position and they want to maintain enough contact with the Ministry and with the Management Committee overseeing the projects to stay abreast of the developments in those areas. The mapper was in the same position, wanting to observe, watching and seeing what happens with those projects. The user was very interested in the costs that would be incurred in these pilot projects. He is interested in the results and is also in a wait-and-see position, not really too anxious to be involved. The user also wants to know what data would be in the system when the pilot project was finished. In general, there was an interest in costs, the implementation time that would be involved and the organizational support structure changes that would occur in the municipalities.

   As an analyst and representing the City of Burlington, we are in a position of looking right now at the property management information system and decided to be actively involved at the pilot project stage. We would like to liaise extensively with the Management Committee overseeing the projects and be involved in what ever discussions and investigation proceed from this point forward.

3. On the subject of other activities besides the pilot projects that could be going on, we feel there should be extensive effort in the educational area to educate politicians, users, suppliers, and so forth to make them familiar with the terminology and with the developments in all of these areas. We feel a lot of people just are not ready for all this, and that it has sprung up quite quickly and that the educational efforts would be well-spent. We feel there should be considerable more emphasis placed on the areas of improving the tabular data in the OASYS and POLARIS systems and that effort be concentrated there as well as in the mapping system. Thank you very much. (Applause)

CHAIRMAN SCOTT: Thank you, Keith. Next group.

Report #17: Louis Stadelman (Ministry of Revenue):

I find it difficult to transcend my own personal views, let alone to gain a consensus within our own group.

1. However, the group felt that accuracy depended on two factors. We felt one is positional and that is a matter of degree, and one is informational. How much wrong information are we willing to accept in a particular system before it breaks down? What kind of controls can you fit into it to keep a high level of accuracy and then therefore liability. In terms of positional accuracy, nothing really earth-shattering was decided upon. Accuracy depends on the priorities that the municipality has at any one particular moment and therefore large municipalities have much greater range of needs and requirements for accuracy of data than much smaller municipalities, which can do

with a much less positionally accurate level of information. Therefore, it comes down to that the municipalities must recognize their needs and then determine a cost-effective approach, in terms of compromising some of those accuracies that they would like to have developed in their particular system.

2. In terms of involvement, I guess we must recognize that this group is a biased group. We are all here because we are interested in discussing land-related information systems. There are approximately 850 municipalities. I dare say probably only a hundred or so are represented and therefore that means that there are a lot of small municipalities out there that, either because of their size, cannot be directly involved in such a meeting as this. Therefore, we would recommend that there be a continual dissemination of data through either a newsletter or progress report coming from the pilot projects, enunciating some of the successes and some of the problems that are being met in a day-to-day basis in these four pilot projects or municipalities. It would also include this grappling problem of accuracy and precision of data that is required.

   In terms of the Ministry of Revenue, I would suggest that our particular aim and involvement would be over the next couple of years through the pilot projects, to determine what level of technical sophistication we are at at the present time. How soon can the OASYS system plug into the co-ordinate data base and produce a map of different land-related features and so on, or vice versa? What is the cost? Can we do it cheaply? To get some clear insight into that in the next couple of years would be tremendously helpful.

3. What actions should we take in the next few years? Well, there should be greater communication, as I said, liaison between data exchange, and I think this Ministry should be much more involved in POLARIS, at least in liaising with the ministries, OBM and this land-related information system.

   The group would like to see, from the pilot projects conclusions that the municipalities obtain a set of guidelines to develop a system, so they can go from point A to B in a cost-effective way. What are the costs, you know, dollars per parcel, dollars per square mile of coverage, dollars per street mile or whatever? I think that is about it. Thank you very much. (Applause)

CHAIRMAN SCOTT: Thank you very much, Lou. How many more groups do we have to report? Put your hands up, please. We are beginning to run rather short of time because Richard has to catch a flight and he still wants to do a wrap-up for us. I think, John, would it be alright that I suggest that the people who are reporting for their group, why don't I ask them if they would come and sit down with you and just take a couple of minutes to give their report to you? Would you do that before you leave? Would you sit down with John for two minutes and tell him the results because I really think that if we are going to stand any hope of giving Richard a chance to wrap this thing up and get out of here by five, we just simply have to move on. Sorry to do that because you went to a lot of effort and

thought to get your ideas down.

Report #18: Mike Hodson (Ryerson Polytechnical Institute):

1. With respect to the question of accuracy, should we reign back from digitization if it is not accurate enough? It was felt that the digitized data would be used in planning but not in design.

   We decided that we should follow the precepts of control surveying in collecting data and that the base map has to be to OBM standards. End users would have to verify that the accuracy is sufficient for their use. Consistency or accuracy of detail or correctness of detail must be maintained.

2. The group decided that the level of pilot project involvement should include keeping municipalities informed with regard to utilization of the system and status reports on implementation, problems and usage.

   Pilot projects are too long and should be completed sooner to show a concrete end product.

3. The Province should guide and act as consultants in this field to the municipalities, so that economies can be made. Provision must be made for transition of office workers from the current practice to data base management system in the form of seminars, etc.

Report #19: John Fisher (EHS - Ministry of Health):

Three different groups of people were at the table: Ambulance (5), land surveyors private industry (3), and MNR - control surveyors (2), therefore different needs were expressed.

1. The land surveyors felt that there is a need to know accuracy is available but accuracy itself is not so critical.

   The representatives of MOH believed that being able to locate call location, urban and rural, requires landmarks to be in the right place and routes to be accurate. A geoplotting of emergency call history would also be of benefit. As far as accuracy goes, discrepancies of 10 or 20 metres would not be critical. The MOH needs to identify dwellings and the best routes to get to them.

   The control surveyors from the MNR felt an accuracy within 2 mm for control network is required. On 1:2 000 scale OBM maps within 1 metre accuracy is suitable. Generally speaking, precision is needed to generate maps.

2. With regard to the pilot projects, the MOH representatives are actively participating in the Cambridge pilot project. They want to test a number of applications for dispatch, planning and available

software. Maybe even have some new software developed for specific applications. Another goal that was identified is to interface with other data bases and the 911 telephone network. There is a general concern that MOH not lose historical information through the transfer process.

The land surveyors feel there is a need for a pilot project in the private consulting area. There is also a concern regarding publicness of the information. The land surveyors would also like to find out where the funding is coming from in the long run and develop a funding plan for the future.

There is a need for continued fiscal commitment and funding mechanism for pilot projects to work.

3. The surveyors - private sector, would like to have the ability to relate the system that develops. A service bureau could be used to provide access to this system information. There was a need expressed for the ability to access the municipal and provincial systems. This, therefore, requires some common formats/protocols to allow for information interchangeability in case of access. Legal implications of this access must be addressed as must confidentiality, security, the ability to protect INTEGRITY of the data base, and the ability to lock off segments of the data base specific to a given agency.

CHAIRMAN SCOTT: We dealt mainly with two levels of government today and now we are going to step up our level and look to the east and find out what this conference has really been all about. We are going to have a summary by Mr. Richard Groot. Mr. Richard Groot is a graduate of the Technical University of Delft, the Netherlands, with a Master of Science and Geodesy, Photogrammetry and Land Surveying. He joined the Surveys and Mapping Branch in the Department of Energy, Mines and Resources in 1967. Following consulting work with the United Nations and the Government of the Netherlands, he became Chief Aeronautical Charts Division in 1971 and Assistant Director Mapping Production Directorate in 1975. In 1977 he was appointed Director Geographical Services Directorate. From 1973 to 1975 he was Director Task Force on Geographical Referencing of the Government of Ontario which designed and implemented the Ontario Basic Mapping System. On September 1, 1982 Richard became Director of the Topographical Survey Division, Surveys and Mapping. Richard. (Applause)

SUMMARY COMMENTS

RICHARD GROOT, Director
Topographical Survey Division
Department of Energy, Mines and Resources

Thank you very much, Mr. Chairman. What I would like to do is to review where we came from, what the significance of this seminar is, and what some of the future issues are, at least from my perspective.

Where did we come from? Well in the late '60s the Committee on Government Productivity identified a major problem with the accessibility and use of geographic information. They said that it was difficult to identify what information is where and if found it was difficult to correlate that information for policy studies or environmental studies. The Surveyor General was identified as the Official to do something about that.

That "to do something about that" began in 1974 when a small team under the then-Surveyor General Robert Code and with members Jack Haddon, Wilf Jenns, John Kerr and myself as director started to apply ourselves to understanding what is wrong with the geographic information in the province and what could be done about it to improve its use and its usefulness. That started in 1974 and we did a major survey of map users because we thought that, obviously, a lot of the information is spatial, geographic and therefore relating to maps. The absence of a systematic base map series meant no "index" for thematic information. Let us, therefore, find out what the map users want.

At that time we were thinking really still in map and graphic terms. Out of this came the design of the Ontario Basic Mapping (OBM) System which was to provide the foundation for relating other thematic information. At that time also we began talking about geographic information systems and because of Jim Linders' involvement we began to see a glimmer of the difference between data base requirements and mapping requirements. But it was all pretty intuitive and we could not really identify what it all meant in terms of systems, what it meant in terms of organization and responsibilities and in practical user terms.

So the highlights of the efforts of the Task Force on Geographical Referencing, as it was then called, was the definition of the OBM and pushing that to Cabinet level and the identification that there is something more about geographic information than just maps. Between 1975 and 1976, there was considerable discussion on this and Bob Code, cautious man as he is, said: "It seems to me we have to talk more to the users". On his initiative the Interministerial Committee was created and that was definitely a very wise decision because we got the users around the table, started to communicate with them and learned a lot from that. One of the things we learned was that we should not only focus on geographic position, but we should also focus on the relationship of geographic items of information. At that time it was decided that we should have a conference

such as this. A seminar where the user and producer could discuss requirements, state of the art, experience and expectations. Well, the results of that seminar hit Bob Code and his team with force because it became clear that they were trying to deal with a pretty large amorphous subject. They pondered the results until 1981 while the Interministerial Committee continued. Another seminar was then called which really was to report on results of the Interministerial Committee work, on the progress in OBM mapping and on some of the experimental work that went on at the University of Guelph under Dr. Linders.

Then things started to pick up. There was another seminar in 1982 and as a result of that, it was decided to find a better way to assess the problem by creating models to think about data base management systems in the field of spatial information for more specific application realms such as municipalities. That decision in my view was crucial because it was the first time that in a systematic and scientific way, information was being collected to derive some generalized models about the information environment, about the systems environment, the requirements for the systems and the generic characteristics of municipal needs. Today, we find ourselves in this seminar discussing these conceptual models in a municipal context with proposals for pilot projects and some future implementation, of course.

So we went through a period of several years when the thinking about geographic information systems, data base management systems was very unspecific, intuitive, and undisciplined. There were no conceptual models to focus on. We talked a bit about topology but we did not know what it meant in practical terms.

When I look at this seminar, I believe that its essence is that we now have, with all the flaws and imperfections that are undoubtedly still there, at least models to focus our thinking on. To help us define what the long range goals are and what we want to achieve in this area of geographic information. In my view, that is a breakthrough because once you have this conceptual context, you can set fairly specific, well-articulated long term goals in terms of the purpose and content of data bases, the architecture and resolution of these data bases, the management of the data, relationships, networks and so on. Now we have a foundation to do that, and because you can develop these long term goals, you can get into more deliberate action and say, "okay, how do we get there"? We may not get there in a straight line because we will be constrained by all sorts of conditions, some of which I will allude to a little later. It does not matter if you do not get there in a straight line, as long as you keep in mind that long term goal.

The future issues pertain, in my view, to the following problem that all of us are faced with. It is how do we provide digital data rapidly now, that is also useful and contributing to long term data base applications without knowing the definitive data base structures and applications. We cannot wait until things are perfect, but if we are clear where we want to get to, we can do at least things in a way that do not jeopardize the long term goals. That would be progess.

Inevitably, those developments mean large front-end investments at a time

of economic restraint and that relates to the political problem we all have. We have to convince our political masters that these front-end investments will have to be made and it will take time before they will see a pay-off. That is no mean task.

There will be a lot of pressure to go rapidly in a straight line to the goal, somewhat faster than our institutional constraints allow us. This pressure will develop because most users will be computer-literate in the next ten years. The kids that are now in university use computers like we used slide-rules. They do not want a typewriter any more, a tool which I thought was a great step forward, they want a typewriter with a screen so that they can correct things. They interact with computers as a normal extension of their abilities. When you get those people in the labour force as users, they want to have the data shared, accessible on their screens, able to do analytical work on it and they do not want to go and ask for tapes somewhere, they want to have it readily available. That creates pressure for us to produce data. I think I am talking up to ten years from now.

Another source of pressure pushing towards faster access to and availability of data is the advent of very powerful personal computers. People will work in areas with $10,000 computer systems in their office with which they can rapidly do all sorts of complicated things. If they find they cannot do things associated with geographic information, then expectations will not be met and the demand for our organizations to respond faster will increase.

There will be insistence on the sharing of information and, therefore, there will be networks of data bases. The insistence will be purely from an economic point of view. We cannot afford as a society the duplication and triplication that has gone on in the past. This will cause political pressures for action involving co-operation between different organizations.

There are some barriers to rapid action. One is in the area where the irresistible forces are: computers plus communication technology encourage decentralization. We do not need large ivory towers any more and we will not need hierarchical organizations. Data and system capability will be accessible in Inuvik, as well as in Ottawa, as well as in Vancouver and the education system will provide the people to them. Input can come from one source, output from another. That is obviously going to impact on the mandates of current organizations and the adaptation will slow us down.

One of the countervailing forces against widespread dissemination of digital geographic information is that we really have not come to grips with the question of accountability for information. In the past, it was relatively simple. The mapping organization was responsible for the information shown on the map. But when the mapping organization is going to derive its information from sources other than air photography, what is going to happen to the accountability for the information? What about security? Do we want our national digital terrain elevation models in the hands of other countries? How do we prevent that from happening? The integrity of systems, royalties, copyright are all issues that have hardly been touched. Our understanding of some of these is as limited as our

understanding of data bases was back in 1974. So that will stand in the way of rapid provision of digital information.

Let us talk a bit about government organizations and the impact of this technology on them. It requires retraining of personnel. Retraining at the technical level and retraining at the executive level. Most executives in mapping organizations have come up in traditional mapping organizations. Many of them need to be updated to cope with the information technology. Retraining of technicians in existing government environments with restricted classifications and pay structures is complex, difficult and slow.

We have to consider of the relationships between federal, provincial and municipal governments. Some of these relationships will change with the introduction of new information technology. We have already heard of the sharing of parcel information between provincial and municipal governments. Who is going to be accountable for the information, who is going to control access, who is going to control the integrity of the data base? Will it be the municipalities, where in fact most parcel-related data is located, or the provincial registry, or assessment office.

The relationship between federal and provincial governments is changing too. Ten years ago, most provinces did not have the staff and the staff competence to address many of the issues that are now being addressed and they went to the Federal Government for advice. Right now, the provinces are pretty competent, at least as competent as the Federal Government and that creates different relationships. So you get shifts in relations between institutions.

Consider now, if you will, the mapping industry. It is an industry of photogrammetrists and surveyors. In the future, this industry will have to find a niche in the "information industry". They will be competing with other industries that are already there. Industries which, because of the economic recession, are looking for other application areas and are discovering the mapping market. This is an issue the mapping industry will have to address. There is now a requirement for high capital investment, and long term commitments on the part of both the industry and its clients.

This will foster different relationships between industry and government. At times of extensive research and development, the rules governing relationships between government and industries are not quite as supportive as we want them, and we may have to find innovative ways to accommodate the new requirements.

Then there are the universities and colleges. How do we involve them? How can we ensure that their input into the market remains relevant? I had an interesting discussion this morning with a professor from Erindale College. When I worked for MNR, one of the things I did on the side was to teach a course on cartographic data management. In 1973/74 there was at Erindale an intuitive sense that the surveying and mapping curriculum should cover this. We did not get much further than covering the design of mapping systems, for example, the OBM system or NTS system. But now that there is a scientific basis being developed, some of which you have witnessed at this seminar, in these conceptual models, the universities and colleges can

go further and, therefore, they have to be deeply and intimately involved with the process that is going on here so that they can ensure the relevance of their associated courses to their students.

And finally the public. The public is in the end paying for almost everything and they have a right to be served. I heard at this seminar somebody talking about a data base application which will ultimately provide building permits. I could not help but think about the problem I had with my credit card company to get a correction made on an error they had caused. It took about six months. I could think of somebody who had contemplated a six million dollar real estate project, trying to get a correction made to an automatically supplied building permit. How credible or desirable are these systems? The systems that we develop and design must meet public requirements. And they have to be credible because if the public does not accept them, they will not be supported and they will fail.

These are merely some of the demands and constraints on the one hand, that pressure us to accelerate and, on the other hand, slow us down. What matters is that we are evolving a clear perception of where we want to go and that we make this known. And this is why this seminar was significant.

For the first time there are some models that we can work with. You will now start to have pilot projects and you will begin to feel the institutional constraints. And therefore these will have to be addressed as separate items in future activities of the Interministerial Committee or whatever mechanisms you are setting up to deal with that. You should expect new organizational and institutional relationships will develop and these will have to be addressed. You must realize that all the players I mentioned earlier: governments, industries, universities, are part of one resource, a very scarce resource. The systems people and the experts that we will need are a scarce resource and you will have to compete with other industries for that expertise.

In conclusion, I believe there is a real urgency to continue the process that has been set in motion and that is reflected in these seminars. As experienced to date, I think that the progress will continue along a long road. We shall have to keep a sense of perspective, that is we have to realize that electronically, we are at a comparable time when Gutenburg invented his printing press. Presently, we stand at the beginning of a completely new era that few of us really understand and we have to grope our way along. But I believe that the progress reflected in this seminar, has been impressive and I wish the Surveyor General and everybody else involved good luck. Thank you. (Applause)

CHAIRMAN SCOTT: Thank you, Richard. It is very nice to get an objective view and I think also that you have given us encouragement to go forward.

As Chairman for the day, I would like to thank you very much for your participation. And now I would like to call on Hugh O'Donnell, the Surveyor General, who will close the Seminar.

CLOSING REMARKS

J. HUGH O'DONNELL (MNR): Thank you, Ray. I will try and be as brief as possible. I also wish to extend my thanks to Dick Groot. He is always most welcome among our group. We appreciate his past contributions and we are looking forward to good ongoing working relations with his Department.

I found the last hour very interesting and rewarding because I think we are on the right track. Many of the comments and points that you have raised are being addressed. We have either already identified them in our plan or have them already done, and of course you have contributed some new ones. In summary, the message is that you would like to be part of the process; and you need advice and assistance with your own particular endeavours in land-related information work.

You have some tall orders as well, such as - "get on with the digitization of the rest of Ontario, it should have been done in the first place", also "let's get on with the densification of control". I only wish I had some of the GO ALERT money, just a very small percentage to be able to do some of these things. It was most difficult to raise funds for the project that we are contemplating. I am personally very interested in seeing integrated surveys established in Ontario. Over a period of time this can be accomplished by designating specific geographical areas where there is adequate coverage. But the process to get that done will probably require legislation and that takes time.

I cannot close the meeting without recognizing certain people in attendance. I want to call out the names and ask the people of the User Needs Study to stand and I would like to ask you to hold your applause until they have all been identified. Roy Audas, Jack Dangermond, Zul Jiwani, Henry Karabella, Ron Kerslake, John Kerr, Jim Linders, Alex Miller, Gabriella Zillmer and Carol Freedman, technical writer, the lady in the background, putting all the reports together, an important and a very difficult task. Also Kevin Kelly and Eugene Marshall who have helped with the visuals at this meeting. Please extend to them a warm applause. They have done a tremendous job, and they have even come in under budget. (Applause)

I would like to thank our two chairmen, Barney Panting and Ray Scott for the excellent work they have done in running these sessions and to all the other speakers. To June Brady and her staff for an excellent job in handling the logistics and registration.

And I would like to thank you for being here. I feel it has been a very worthwile experience and we will be back, of course, with all our problems and I suspect that we will have plenty to share with you resulting from the pilot projects. Thank you all very much. (Applause)

END OF SEMINAR